ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

APRIL 1955

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An expert looks at . . . .

Titanium's Future

Sponge, $1.15 per lb. . . Plant, 30,000 tons per year . . . P 72

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ALL PARTS IDENTICAL EXCEPT: IMPELLERS AND ENGINE-SIDE SHELL HALF-LINERS

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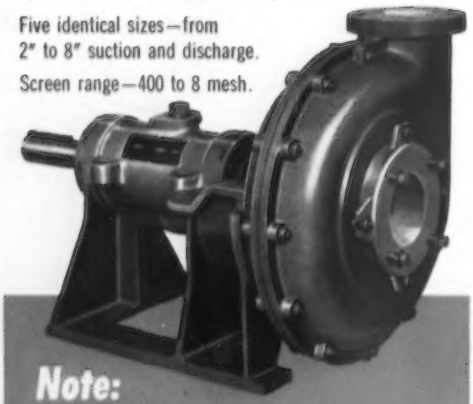
Hydroseal and Centriseal Slurry Pump

Five identical sizes—from 2" to 8" suction and discharge.
Screen range—400 to 8 mesh.



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These are in addition to the complete line of Sand and Dredge Type Hydroseal Pumps

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SAND, SLURRY & DREDGE PUMPS
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Underground Life Lines of Manhattan

Third Lincoln Tube now brings total to 41... drilled with Ingersoll-Rand equipment

TWENTY vehicular tunnels now link Manhattan with the mainland, New Jersey and Long Island. Each tunnel consists of two separate bores. A third bore now being added to the Lincoln Tunnel will bring the total to 41. It will also keep Ingersoll-Rand's 79-year-old record intact. For here, as on all other Manhattan tubes since the very first one, Ingersoll-Rand drills have been used on the rock work.

The western end of this new Lincoln tube calls for driving through rock approximately 750 ft. of 34 ft. circular tunnel. It is being driven in two sections from the bottom of a shaft 130 ft. deep. After careful consideration of all modern tunnel driving methods, I-R Jackdrills and 1⅜" Carset Jackbits were selected for driving the top heading. The bench will be driven by Ingersoll-Rand Wagon Drills.

When it comes to drilling rock, remember that I-R can supply everything you need from the bit all the way back to the compressor. Let your Ingersoll-Rand representative help plan your next rock job. His experience may be of great value to you.

5-91

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ENGINEERING AND MINING JOURNAL

89th YEAR OF PUBLICATION

VOL. 156 No. 4

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LETTERS

Arming the Mill Man

In the February issue, Professor Arbiter's milling review mentioned research work at New Broken Hill, Australia, showed rock drill lubricants may have a detrimental effect on flotation.

This subject was given considerable study by the writer when connected with Anaconda Copper Mining Co. in Butte during 1940-1941, and later in the research laboratories of American Cyanamid Co. Findings were reported in June 1947 *Engineering and Mining Journal.*

Earl C. Herkenhoff

• *"Tests show that rock drill oil can be beneficial or detrimental to flotation depending on the kind of ore and reagents used, and type of separation sought . . . If a particular ore and oil upset the flotation circuit . . . the operator ought to know it. Conversely, if the oil is beneficial, the operator . . . (would be) armed (against) mysterious 'changes of ore' which sweep through a mill from time to time." The foregoing is from Mr. Herkenhoff's article,* E&MJ *June* 1947, *page* 88.—*Ed.*

A Matter of Sulphide

I have read with great interest the article "Basic Break-Even Formulas Devised to Simplify Mine Evaluation" in your issue of November 1954 by Mr. H. M. Callaway. I think this article is notable and very well written but there is something which I cannot understand.

On page 91 in the first example, it is given 60% as assay of zinc concentrate and the applied formula is as follows:

$$Cmm = \frac{SP\ (G-t)(1-r)}{c-t}$$

where c = 60% or .60 (according to the data) but it is written:

$$Cmm = \frac{100(.0481-.01)\ (1-.06)}{.894-.01}$$

Would you please explain to me why this is .894, instead of .60?

Hugo Vásquez Rosas
Lima, Peru

• *All assays are expressed in terms of ZnS. Thus 60% zinc concentrates contain 89.4% ZnS.—Ed.*

Drilling Dilemma

I am working for Royal Netherlands Harbor Works. I have the supervision of the quarries. We are drilling with a wagon drill . . . but we are having difficulty getting the boring powder out of the holes. The wagon drill can't get it out below a depth of 3 meters. We now have made a long pipe, about 6 meters, and it goes into the hole together with the drill iron. We have been able to get the boring powder out to 5½ meters.

J. J. M. van Neer
Mersin, Turkey

RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER

Rubber belt drains off water to speed ore washing

RIDING up that conveyor belt is crushed iron ore, still sopping wet from the washing that removes sand or silica.

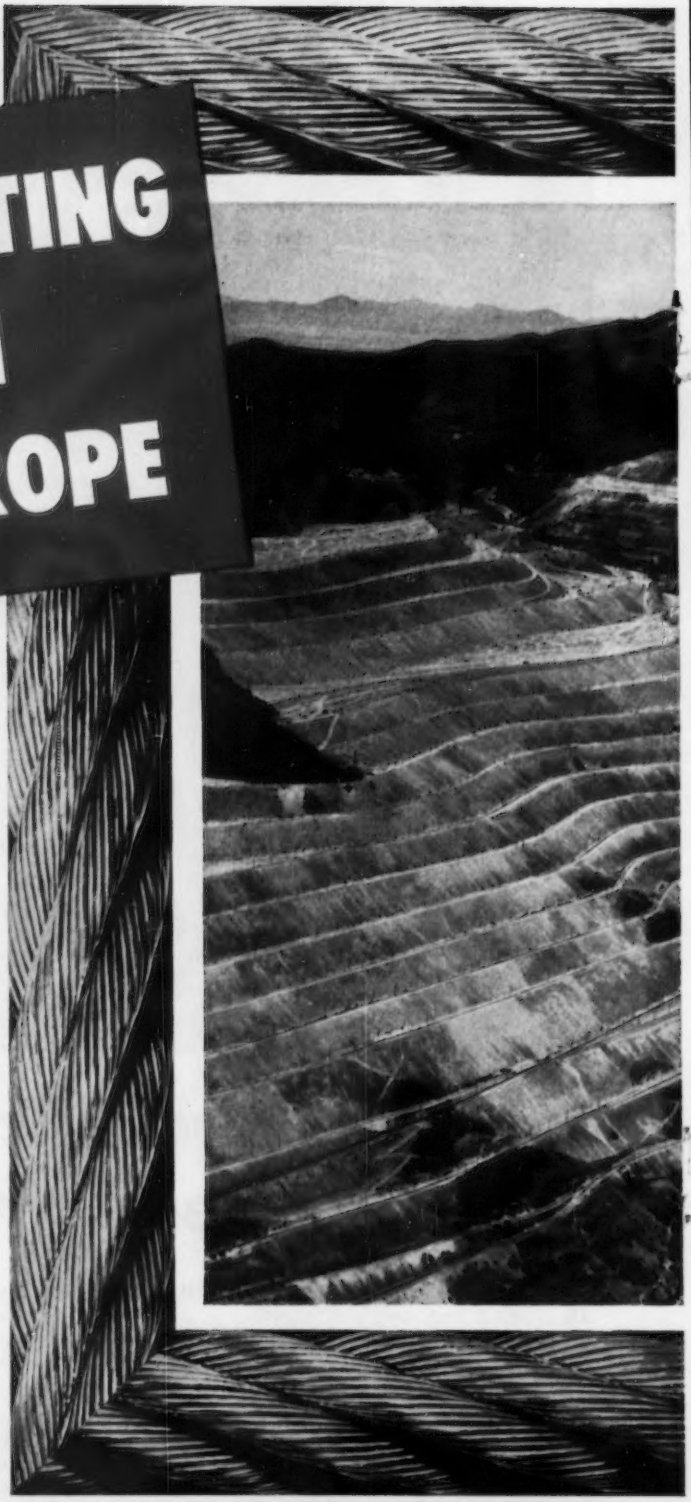
As you can see, this is no ordinary belt. If it were, water seeping down through the ore would form a pool at the bottom of the belt trough, and wash the ore down the 20° incline. That's why the Riffle Grip belt you see here was recommended by B. F. Goodrich.

You'll notice that the Riffle Grip belt has a series of rubber ridges molded into the cover. It's this tread with angular steps that holds the ore in place, and, at the same time, channels water to the edges of the belt where it flows off. B. F. Goodrich engineers developed this belt to solve a gold dredging problem. And it is such an improvement over ordinary belts that it's now widely used in mining operations, sand and gravel plants, and other places where wet materials must be carried up steep inclines.

This same belt works equally well on jobs where moisture must be *held*. By changing the incline angle and the troughing idlers, the steps become a series of horizontal ribs which can carry such sloppy materials as wet mixed concrete and keep the water from draining away.

With its ability to shed water or retain it, as the job requires, the B. F. Goodrich Riffle Grip belt is making many mining and processing jobs cheaper, more efficient. Your BFG distributor will give you complete details on how this unusual belt can solve your wet material handling problems. Or write *The B. F. Goodrich Company, Dept. M-401, Akron 18, Ohio.*

B.F. Goodrich
INDUSTRIAL PRODUCTS DIVISION



TOUGH, LASTING PROTECTION FOR WIRE ROPE

WHEN TEXACO CRATER is applied to wire rope, it penetrates quickly and thoroughly—coating each metal strand with a sturdy film that resists wear and rust. It also surrounds the hemp core, preserving its strength and life. That's how *Texaco Crater* keeps wire rope strong longer, reduces maintenance costs.

Use *Texaco Crater* on open gears, too. It clings to the teeth, won't ball up or throw off, cushions shocks and heavy loads. On both wire rope and open gears, you may prefer the convenience of liquid application. If so, use *Texaco Crater X Fluid*—it goes on quickly and easily without heating, and stays on just like the regular *Crater*.

Lubricate mine car wheels with *Texaco Olympian Grease*. Winter as well as summer, it assures easy starts . . . full protection for bearings . . . less upkeep expense.

A Texaco Lubrication Engineer can help you lubricate effectively all your mine equipment. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

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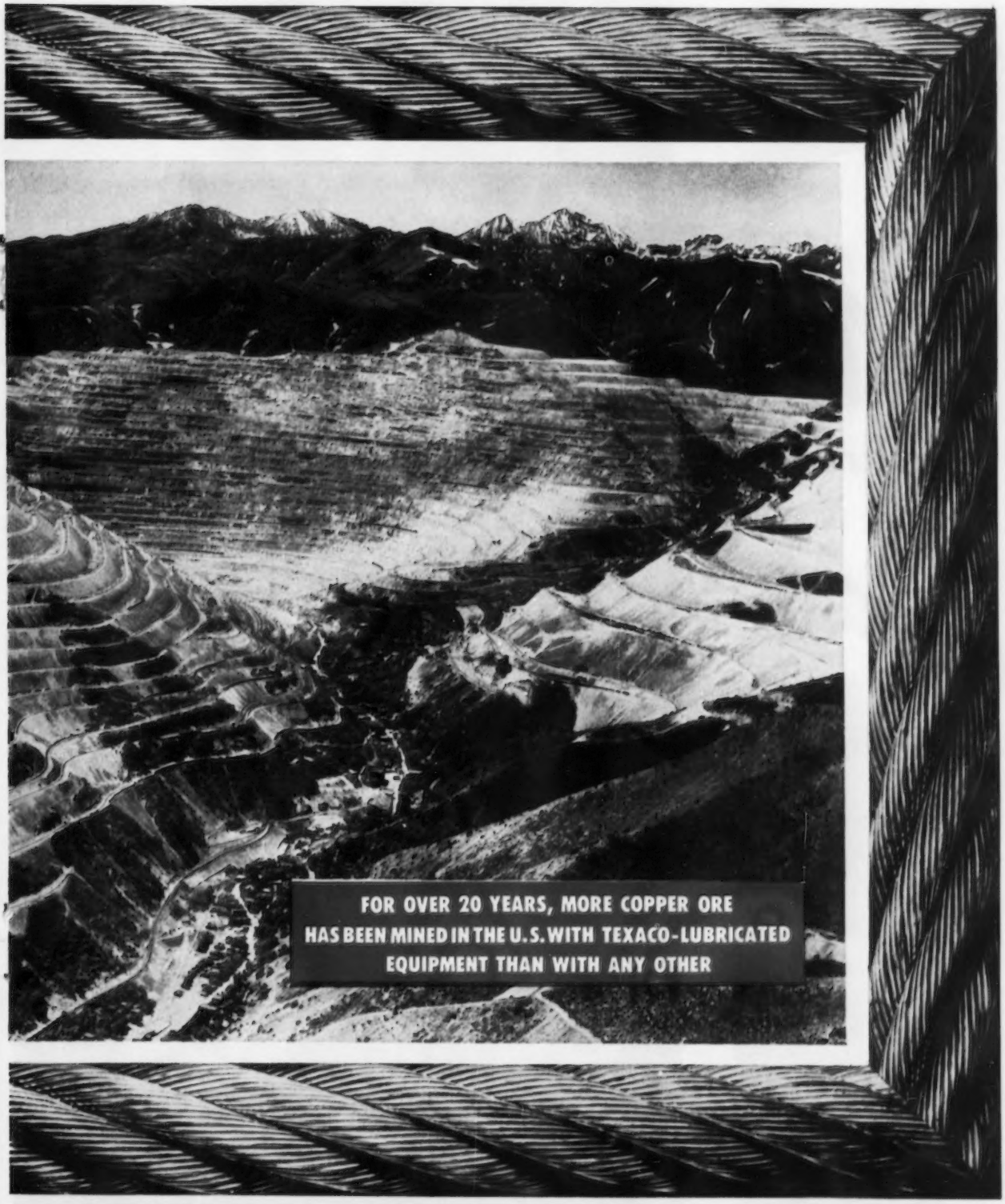
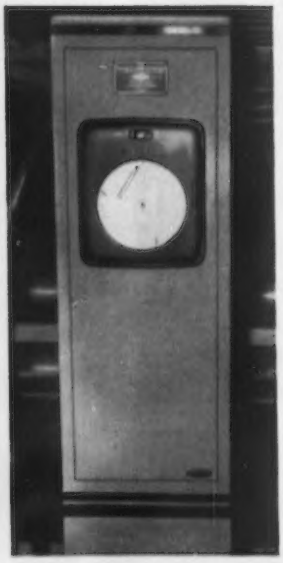


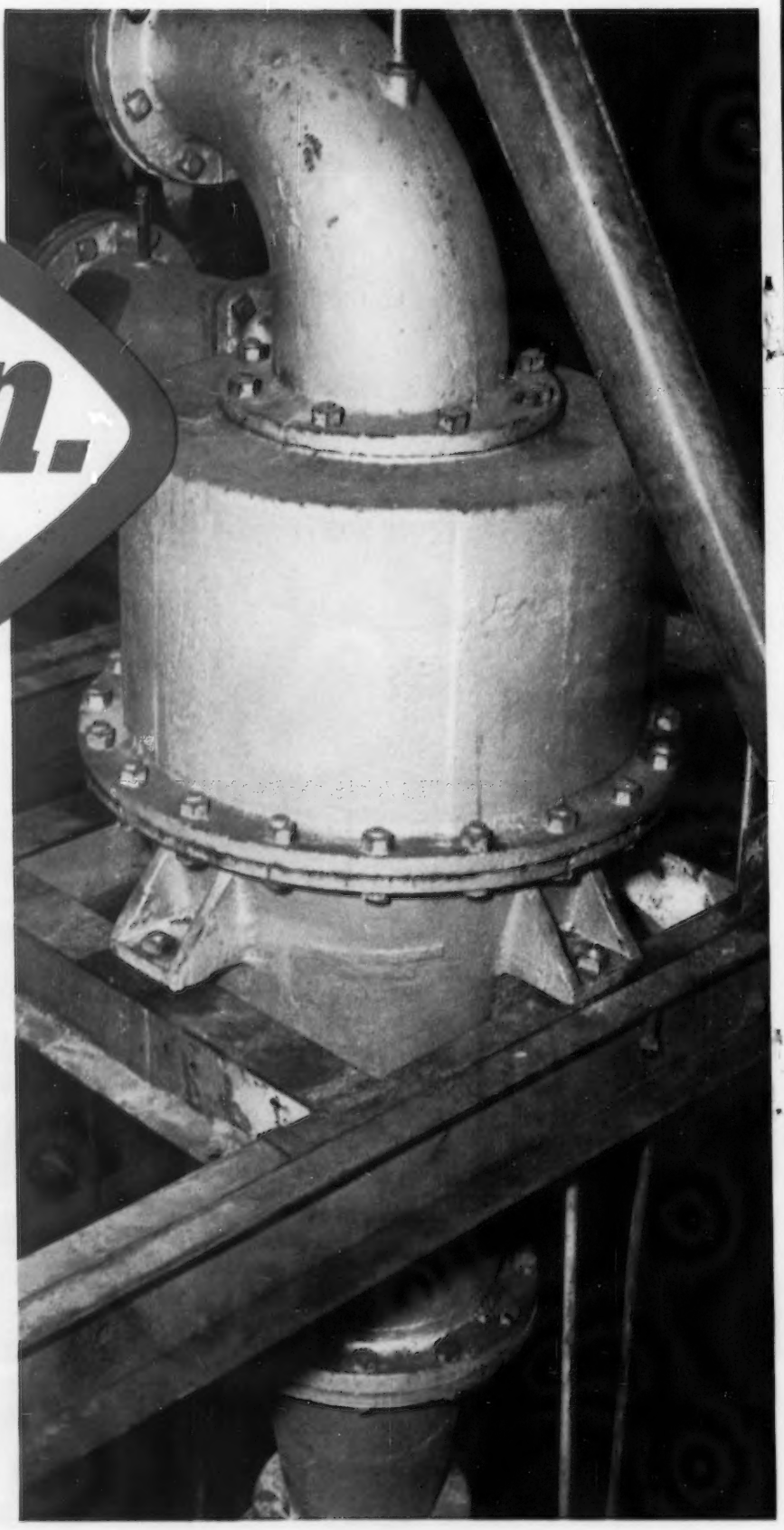
Lubricants and Fuels

FOR THE MINING INDUSTRY

24 in.
Diameter



DorrClone and Vactrol installation at the Quincy Mining Company's Reclamation Plant.



24 HOUR SERVICE

DENVER EQUIPMENT

DorrClone*

Eliminates Bottleneck . . . Keeps Copper Reclamation Plant Operating at Full Capacity

The Quincy Mining Company's Reclamation Plant on the Keweenaw Peninsula, Michigan was faced with the problem of decreased plant production caused by periodic over-abundance of minus 48 mesh fines in the feed which the regular dewatering circuit could not handle.

The plant was rebuilt in 1943 to recover much needed copper from over 30 years accumulation of tailings from the old Quincy Mill which were deposited in Torch Lake.

Key to the solution of the production bottleneck was the installation of a 24″ dia. DorrClone equipped with Vactrol* underflow control. This unit, which is turned "on" and "off" as needed, feeds a dewatered, deslimed and polished product directly to the flotation cells.

In addition, there were indications that the scouring action produces a polished mineral surface, thereby increasing recovery. The added feature of the Vactrol controller has permitted regulation of the underflow density within very narrow limits during operational periods when the plant feed varied widely in particle size distribution.

Since its installation in July 1952, it is estimated that the DorrClone has operated 3,000 hours with no evidence of wear or any maintenance costs.

If you have a degritting or desliming problem, there is a good chance that the DorrClone, with its high-capacity-for-size, will provide the solution. Write for Bulletin No. 2500 to Dorr-Oliver Incorporated, Stamford, Conn., or in Canada, 26 St. Clair Avenue East, Toronto 5.

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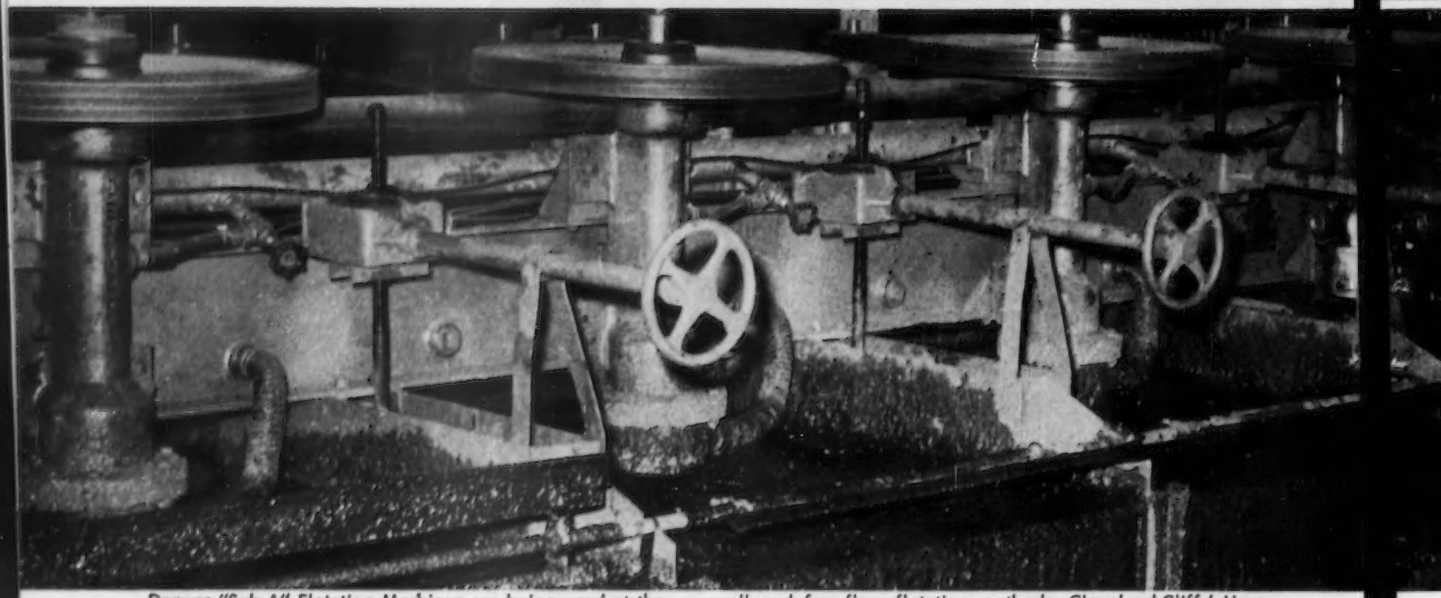
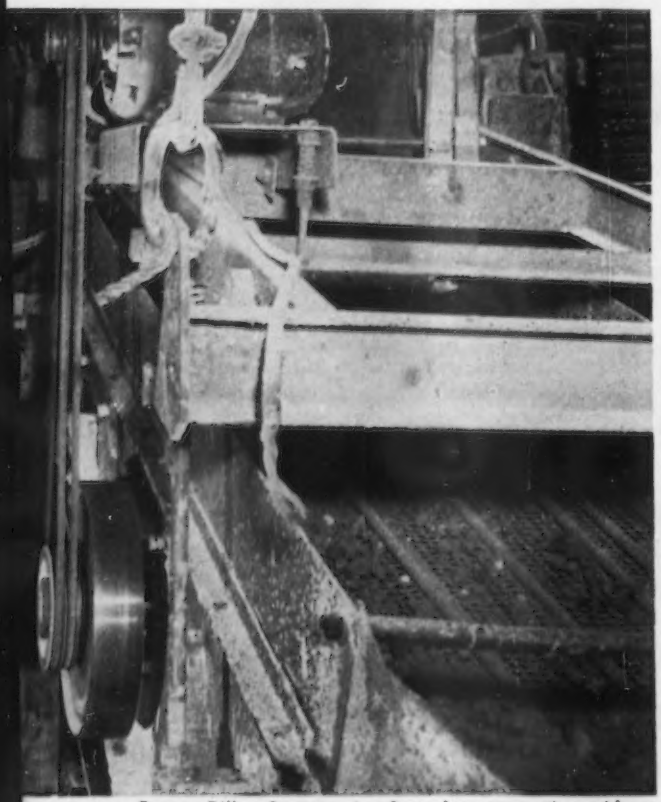
IN THE NEWS . . .

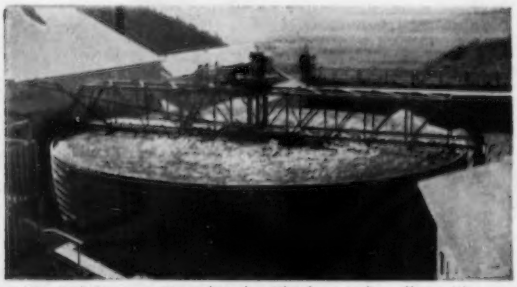
DENVER EQUIPMENT



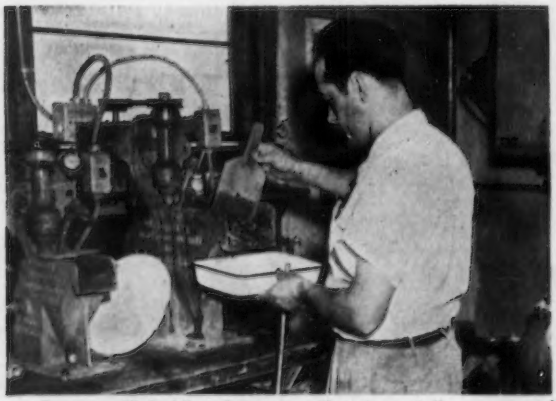
Denver "Sub-A" Flotation Machines are being used at the mill of the Humboldt Mining Co., operated by the Cleveland-Cliffs Iron Co., near Ishpeming, Mich., to float specular hematite iron ore. A fatty acid reagent is used. This photo shows a No. 24 (43x43) Denver "Sub-A" Flotation Machine in the Rougher Circuit. This bank of cells incorporates both cell-to-cell and free-flow flotation methods. Cleveland-Cliffs' Humboldt Mill is also using Denver "Sub-A" Flotation Machines for cleaners and recleaners. Additional information on how Denver "Sub-A" Flotation and Denver "Sub-A" Super Rougher Flotation Machines handle large tonnages is available. We want to help you solve your metallurgical problems. Item 311.



Denver-Dillon Screens give fast, clean separation without blinding. You get an even, smooth flow of material because of the patented "true-circle" action. Two bearing construction gives up to 50% savings in power. This mill photo shows the even distribution of the oversize—no blinding. Item 313.



60'x12' Denver Spiral Rake Thickener handling Fluorspar middlings from cleaner flotation cells. Patented Denver Spiral Rakes tend to eliminate overload due to their rapid removal of settled solids. Underflow metered with Denver Adjustable Stroke Diaphragm Pump. Item No. 315.

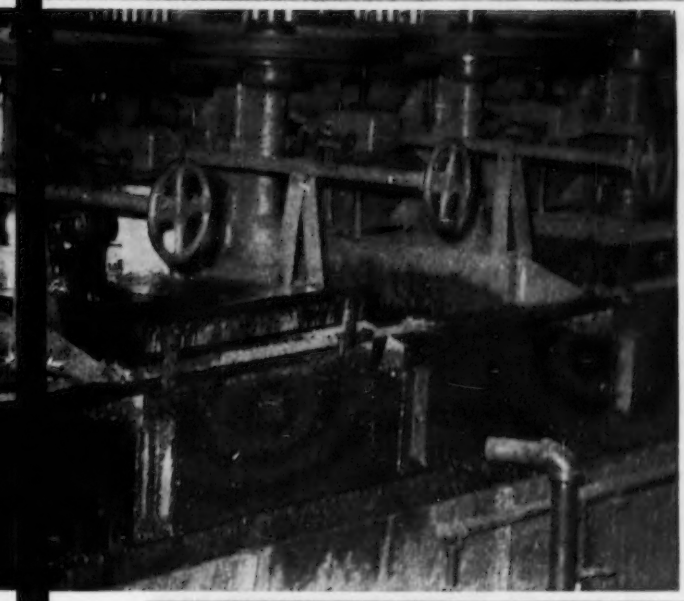


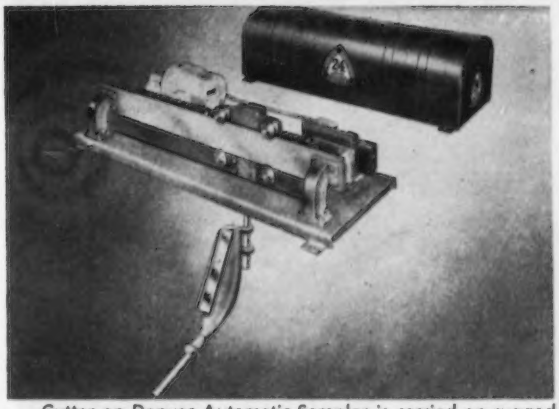
Denver "Sub-A" Laboratory Flotation Cells are used extensively by companies all over the world to check mill operation and maintain careful mill control. If you need lab equipment DECO has a complete stock—or you are welcome to use the Denver Laboratory Service for batch or continuous tests, or other problems. Item No. 317.

"The firm that makes its friends happier, healthier and wealthier"

DENVER EQUIPMENT CO. 1400 17th St., Denver 17, Colorado

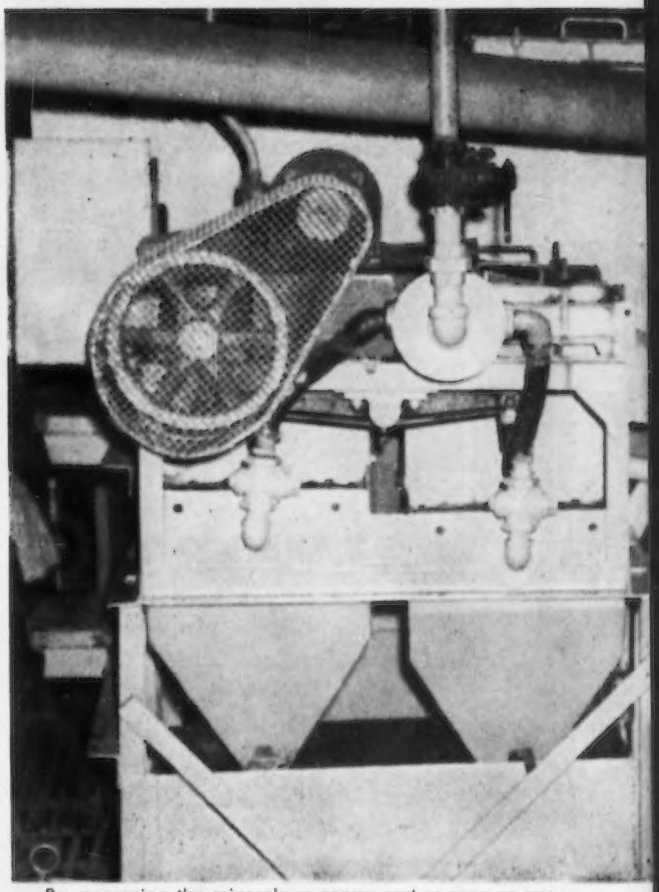
IN THE NEWS . . .



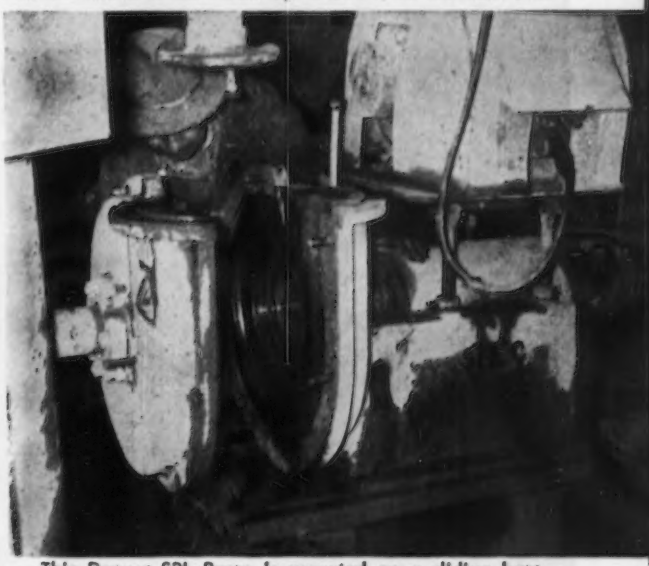


Cutter on Denver Automatic Sampler is carried on rugged ball bearing roller assembly, replacing old-style sliding contact. Rolling carriage allows the cutter to move through the stream of material to be sampled at a uniform speed. Frequency of sample cutting easily regulated. This gives accurate percentage samples, always. Item No. 316.

The 1955 Denver Wall Calendar and Mill Chart, and the 1955 Denver Annual Diary are being sent to everyone on our DECO Trefoil mailing list. If you would like to receive these two useful items, and DECO Trefoil, without cost to you, please send us your name immediately. Item No. 318. Sorry, but this offer can be extended only until Dec. 31, 1954.



By recovering the minerals as coarse and as soon as possible, Denver Selective Jigs avoid losses by over-grinding and sliming. Denver Jigs handle unclassified feed, make both fine and coarse concentrates. Up to 800 T/24 hrs. Item 314.



This Denver SRL Pump is mounted on a sliding base—making it easy to move pump back for quick inspection or parts replacement. Rubber - bonded - to - steel lining not only gives longer wearing part life, but also increases efficiency and lowers horsepower requirements. This 3"x3" Denver SRL Pump is used to pump cleaned zinc concentrates to cyanide circuit. Item No. 312.

WRITE TODAY, FOR ADDITIONAL INFORMATION . . . Please request additional information by the Item Number.

COLORADO SPRINGS, 500 South Sexsmith Street, Phone MElrose 3-7158.
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We take pride in Walworth's share in this momentous achievement. For, from the days when the *Nautilus* was still on the drawing board to the last stage of construction, Walworth engineers worked directly with the Electric Boat Division of the General Dynamics Corporation—helping with the myriad of piping problems this new concept of transportation posed. Now the *Nautilus* prepares to join the fleet with Walworth Valves and Fittings, both standard and special items, installed.

We are glad to be aboard.

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Manufacturers since 1842

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Profits keep coming in when pay loads keep moving out
Choose
MANCHA
Storage Battery Locomotives
They're built to keep going

This Mancha is working in an isolated Canadian gold mine. It has been on the job steadily for the past twelve years.

In isolated locations, where transportation of equipment to and from the mine is difficult and expensive, locomotive breakdowns are especially serious—*trouble-free operation* of prime importance. That's why, in mines hard to reach, you see so many Mancha locomotives on the job. MINE MANAGEMENT AROUND THE WORLD COUNTS ON MANCHA FOR THE *UNINTERRUPTED PERFORMANCE* THAT SPELLS PROFIT.

Will a Mancha Storage Battery Locomotive pay in your mine?
Whether or not you are in the market for new haulage equipment—

YOU CAN HAVE THE ANSWER NOW!

Simply ask for a "data record form." Fill it in and mail it back to us.

The data will enable us to tell you if Mancha locomotives can be profitable for you.

Mail the coupon today, and have valuable haulage information for consideration now, and in the future.

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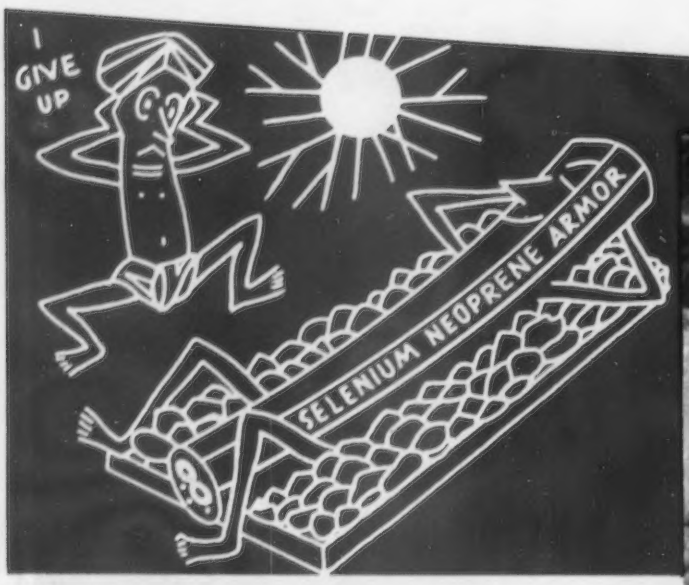
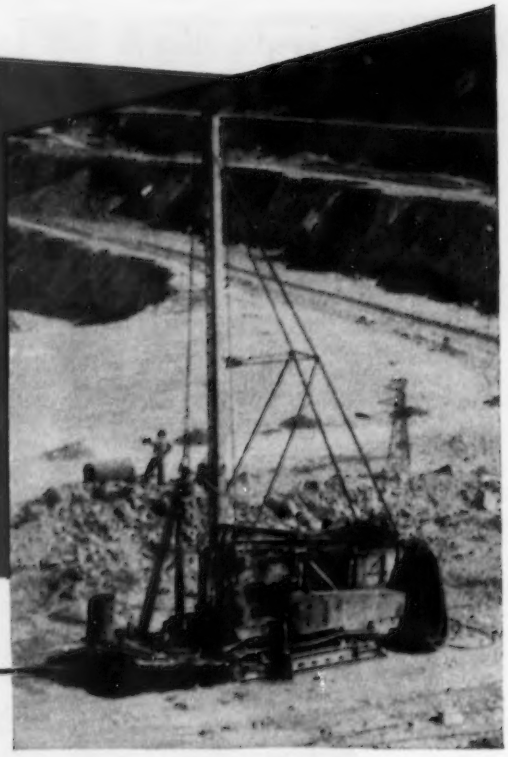
Division GOODMAN Manufacturing Company
4850 South Halsted Street, Chicago 9, Ill., U.S.A.
E & MJ-455
Send your "data record sheet."

NAME _____
FIRM _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

MANCHA STORAGE BATTERY LOCOMOTIVE
Division GOODMAN *Manufacturing Company*
4850 SOUTH HALSTED STREET CHICAGO 9, ILL., U. S. A.





TOUGHER THAN TOUGH!

because it's SELENIUM NEOPRENE

The drawing above, amusing though it may be, is an accurate rendition of one of the problems that faces a cable attached to a drill. Strong sunlight tends to harden some cable jackets and make them brittle. Ultraviolet rays found in the sunlight help to cause cracks by forming ozone. These cracks are the point of entrance for moisture, dirt, water, and more sunlight. Eventually the cable breaks down from these causes.

This is not so with TIREX. Its cured-in-lead Selenium Neoprene Armor will continue to protect the insulated conductors regardless of the operating conditions, including strong summer sun. Samples of TIREX Selenium Neoprene Armor have been exposed to sunlight continuously for nearly twenty years and still show no signs of cracking.

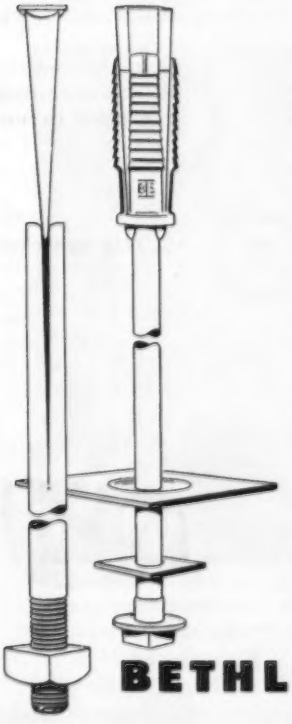
TIREX was made to meet the problems encountered in mining. It was the first heavy-duty portable cord or cable made in this country. TIREX still leads the field by having the toughest, most abrasion-resistant jacket known. If you aren't using it now, why don't you get some and see how much more work you get per length of TIREX. Your local electrical supply house has TIREX in stock, or can get it for you quickly.

ONLY *Simplex* MAKES

SELENIUM NEOPRENE ARMORED **TIREX**

SIMPLEX WIRE & CABLE CO., 79 Sidney St., Cambridge 39, Mass.

Look What You Get With Roof Bolting!



When you install roof bolts in place of antiquated roof supports, you promote safety by minimizing the possibility of serious roof falls. Not only that, you also get increased production, because roof bolts make possible wider openings and clearances, and more room in which to operate mechanized equipment. Ventilation is improved, too.

Roof bolts make these advantages possible because they reinforce the rock structure to prevent sagging and breaking. They also eliminate a fire hazard.

Described here are Bethlehem's headed and slotted types of roof bolts, either of which will be helpful in obtaining better, safer operating conditions.

SQUARE-HEAD BOLTS

Three sizes: A ¾ in. carbon-steel bolt, and a ⅝ in. high-strength bolt, each with minimum breaking load of 20,000 lb; also a ⅞ in. high-strength bolt, having a minimum breaking load of 40,000 lb.

Bethlehem also makes a hardened washer for use with these bolts. It reduces the friction between the bolt head and the roof plate that occurs when high tension in the bolt produces excessive bearing pressure. The washer permits the free use of impact wrenches, without galling or tearing of metal.

SLOTTED BOLT

A 1-in. bolt, with a centered, forged slot. No metal is removed in slotting. Opposite end of bolt has 5 in. of rolled threads. Bolt is for use with steel wedge, in 1¼ in. hole. When bolt is driven, wedge is forced deep into slot, expanding the bolt-end. Truncated-cone point prevents damage to threads. Usually comes with American Standard regular square nut.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

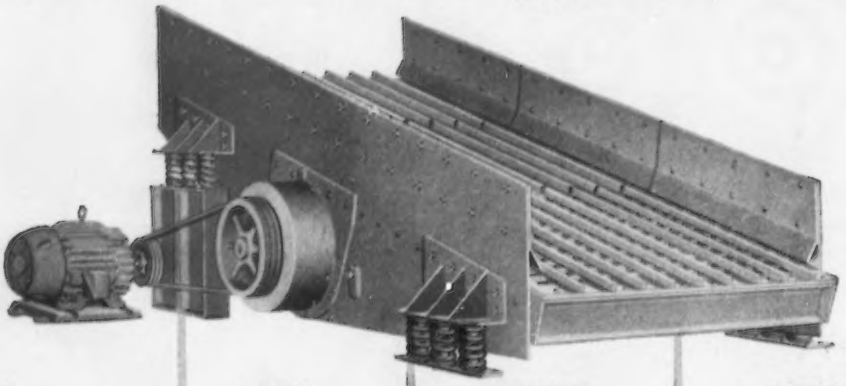
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM MINE ROOF BOLTS

BETHLEHEM STEEL

Heavy-duty scalping's BIG 4

...your assurance of top performance



1 GREAT STRENGTH

Massive frame utilizes heavy-section ship channels and H-beam members. Welded deck is securely riveted to thick side plates. This stress-relieved construction easily withstands up to 40-in. boulders dropped from feeder.

2 HIGH CAPACITY

Efficient vibrator mechanism permits screening extremely high capacities of sticky ore. Deck can be perforated plate or grizzly.

3 EFFECTIVE SEPARATION

All vibration is isolated from foundation by large, square-end helical springs and concentrated in the live deck for thorough action of the deepest bed.

4 TROUBLE-FREE OPERATION

Automatic controls limit motion during acceleration and deceleration. Over-size, self-aligning, taper-bore roller bearings with hydraulic bearing removal device insure long life and ease of maintenance.

New LINK-BELT vibrating screen combines all the features essential to low-cost ore handling

HERE's the ruggedness of a grizzly teamed with the proved efficiency of a vibrating screen. Developed by Link-Belt to meet every requirement of the Range—it's the ideal answer for heavy run-of-pit applications.

Your Link-Belt representative can give you complete information on this new heavy-duty scalping screen. Contact him today, or write for your copy of Folder 2461.

LINK-BELT

VIBRATING SCREENS

Note the size of the large boulder handled by 5 x 14 ft. Link-Belt heavy-duty scalping screen at a mining firm's Mesabi plant.

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, Duluth 2, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa), Sydney (Australia). Offices in Principal Cities. 13,324

Vertical VACSEAL Pumps

— handling dilute sulphuric and phosphoric acids containing sludge — at a large steel fabricating plant in a

PICKLING (dry-pit) OPERATION

The 3 in. Vertical Vacseal Pump transfers spent acid-sludge from pickling and wash tanks to tailings pond. The pickling tank and pump are installed in a concrete pit. Under normal conditions this is a dry-pit operation, but if the pit should become flooded due to the tank failure, this pump would continue to operate and can be used to drain the pit. This operation has proved quite satisfactory.

Versatile . . . dependable

The versatile Vacseal Pump meets a wide range of requirements in many industries—handling slurries and/or chemical solutions. Direct and V-belt drives provide optional motor mountings. Natural rubber, Synthetic lining or alloy parts available to suit service conditions or requirements. Vacseal pumps are covered inside and out for wet pit operations. The sizes: 2″, 3″, 4″, 6″ — lengths 3 to 10 feet.

— handling mine slurries and acids containing solids from precipitation tanks in a large copper mine — in a

MINING (wet-pit) OPERATION

One portable 3 in. vertical Vacseal Pump serves in both underground and above ground applications. It handles material from precipitation tanks to filters and pumps about 300 GPM of 2.1 sp. gr. pulp of heavy cement copper against a 45 ft. head. The same pump is used in several clean-up applications, removal of silt from settling rings and delivery of yellow ochre to underground mine cars. In use 3½ years — the only replacements, a back plate and a suction cover.

Other Galigher Products

Horizontal VACSEAL Pump
Commercial and Laboratory AGITAIR
Acid-proof Sump Pumps
Laboratory Ball Mills
Geary-Jennings Sampler
Geary Reagent Feeder
Laboratory Pressure Filters

Leaders in Experience & Service

THE GALIGHER CO.

METALLURGICAL DIVISION • ENGINEERING SERVICE

CONSULTATION • ORE TESTING
PLANT DESIGN • GEOLOGIC INVESTIGATION

HOME OFFICE: P. O. Box 209 • Salt Lake City, Utah
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How AMSCO® helps you HARDFACE MORE EFFECTIVELY

The complete line of 15 Amsco hardfacing rods represents a selection of the toughest, hardest alloys available. Among the metals used for alloying are these highly wear-resistant elements—manganese . . . chromium . . . nickel . . . cobalt . . . tungsten . . . molybdenum. Each has particular resistance to certain types of wear—including impact, abrasion, heat, corrosion.

Your Amsco distributor has many helpful methods for selecting the proper hardfacing rod to most effectively combat types of wear you contact daily. *Make him your hardfacing headquarters.*

AMSCO CATALOG MAKES ROD SELECTION EASY

Write for the free catalog, *Amsco Hardfacing Alloys.* It presents complete analyses, metallurgical information and other pertinent data about Amsco's complete line . . . making it easy for you to look up the right rod to use in hundreds of common hardfacing applications. It is easy to understand and to apply the suggestions to your own operations. Send for it today.

AMERICAN Brake Shoe COMPANY

AMERICAN MANGANESE STEEL DIVISION
Chicago Heights, Ill.

ALLIS-CHALMERS PRESENTS TWO NEW, POWERFUL DIRT MOVERS

...meeting the stepped-up needs of the construction industry for more power...better performance...longer life!

the HD-21

204 net engine hp
44,000 lb

Introducing

- A Great New Power Team with New Allis-Chalmers Diesel Engine and Advanced Design Torque Converter!
- 20% Greater Over-all Tractor Performance!
- New Durability Clear Through!

the TS-360 MOTOR SCRAPER

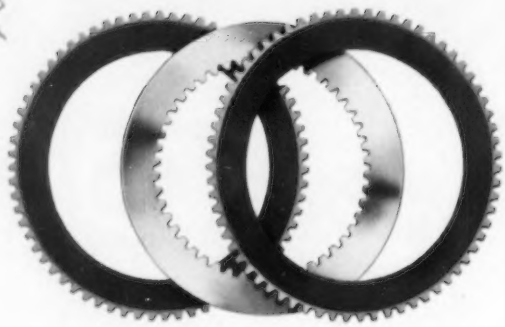
280 hp
20-yd capacity

- Higher Standards of Production!
- New Long-Life Strength!
- More Operator Advantages!
- New Design, Construction and Service Simplicity!

Bigger-better! Tested-proved! READY NOW!

New multiple-disc cable control

With a new safeguard switch that automatically stops cable travel at maximum lift . . . prevents cable shock, increases cable life.



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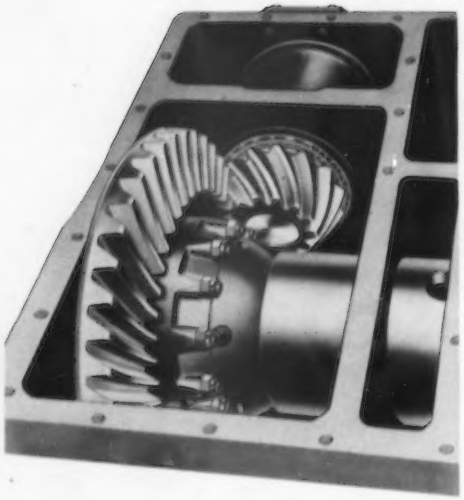


NEW...FRO

B

New heavy-duty gears

The TS-360's ring, pinion, differential and final drive gears are completely new in design and weight to produce new standards of strength and durability.

ALLIS-CHALMERS

TS-360

MOTOR SCRAPER

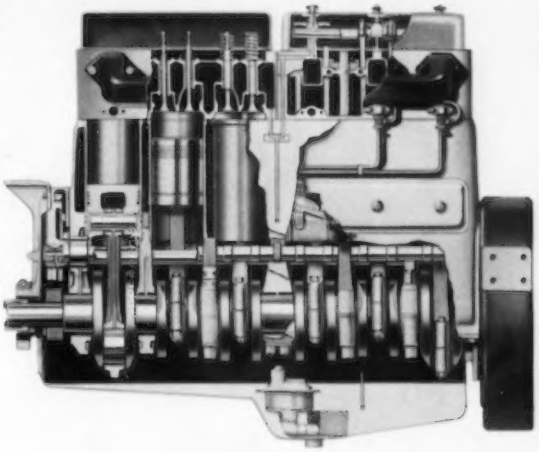
New operator comfort

Plenty of leg room, convenient control, no fan blast, conning tower visibility.

Nou

New high-torque Allis-Chalmers engine

Here's an 844-cu-in. power plant that delivers smooth power over a wide range of speeds . . . with plenty in reserve to assure real dependability and low operating cost.

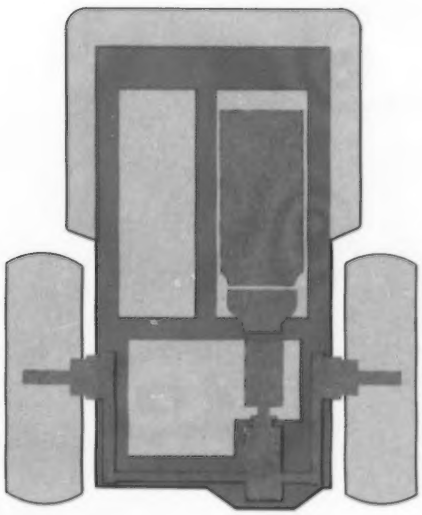


New direct electric starting

Provides easy, all-weather starting with a turn of the key.

RONT TO BACK

Built to outperform!



SPECIFICATIONS

CAPACITY	Struck, cu yd—15 Heaped, cu yd—20	
SPEEDS mph at 2100 rpm	First	3.0
	Second	6.1
	Third	11.3
	Fourth	20.0
	Reverse	3.1
WEIGHT	49,000 lb	

New serviceability

With its new main frame, the TS-360 offers the simplicity of unit construction... easy removal and servicing of both major and minor assemblies.

New double-safety air brakes

Assure ample braking pressure at all times.

New selective steering

Provides a controlled flow system for easy maneuverability in tough going . . . fine control for safe, high-speed steering on the haul road.

New low-mounted headlights

Insure maximum road illumination for nighttime operations. Sealed Beam lights easily adjustable to any position.

lowhere can you match these two . . .

NEW BIG-YARDAGE WORK CAPACITY

Power that pays The TS-360's great new Allis-Chalmers engine spearheads a whole new power train that offers more rim pull at all speeds for better loading, hauling and spreading performance . . . faster acceleration, easy shifting and quick getaways. Combined with new 20-yd capacity, this all adds up to fast, high-volume, high-profit work cycles.

New operating ease and safety In addition to big-job power and gearing, the TS-360 Motor Scraper offers everything an operator needs to work easily, yet efficiently . . . new Double-Safety air brakes, new selective steering, direct electric starting, new multiple-disc cable control . . . and many others you'll want to know more about.

Strength to back it up! The new TS-360 is built around a new, all-welded, heavy steel main frame that makes possible the service accessibility of unit construction. What's more, there's an all-new final drive gear train, with new gears, shafts and bearings. These and many other advantages mean more work done, lower maintenance cost and longer equipment life.

ALLIS-CHALMERS

TS-360

SPECIFICATIONS

The inside facts

BIGGEST MOST POWERFUL CRAWLER IN PRODUCTION...ANYWHERE!

New standards of output The HD-21 introduces the new Allis-Chalmers engine and a great new power transmission team. Together, they provide extra speed with any load, extra pulling power at any speed . . . wider speed ranges and more range overlap. And with its advanced design torque converter (*the result of 15 years of experience by Allis-Chalmers*) the HD-21 puts its power to work with less shifting than ever before possible . . . to help you reach a new high in efficient, profitable production!

New standards of durability From the new Allis-Chalmers diesel with "follow-through" combustion to new, heavier Tru-Dimension track, the HD-21 is built to take today's big loads in stride, and come back for more. Here are just a few more of the long-life features you can't get from anyone but Allis-Chalmers . . . at any price: all-steel Box-A main frame, straddle-mounted final drive gears, 1,000-hour truck wheel lubrication, oil-enclosed track release mechanism.

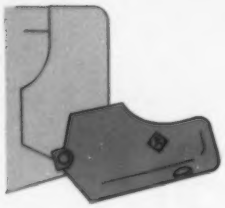
New low cost per unit of work The HD-21's outstanding performance and durability provide a new measure of tractor value. Add the *planned* approach to service offered by Allis-Chalmers dealers, and it's the ideal team for men tackling today's *big* jobs.

SPECIFICATIONS

ALLIS-CHALMERS

HD-21

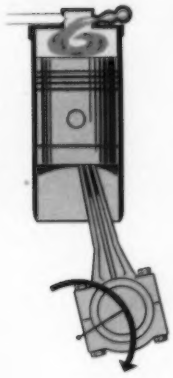
The inside facts



New "wrap-around" radiator guards

The cost of mounting bulldozers is reduced because hydraulic rams or cable-lift sheaves mount directly on new "wrap-around" guard. For easy service accessibility, guard tilts forward.

New Allis



NEW...FROM TRACK

Built to outlast all others!

SPECIFICATIONS

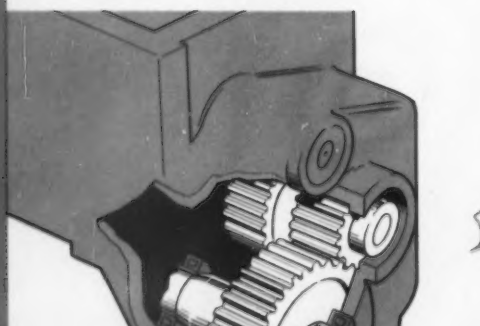
WEIGHT 44,000 lb
204 flywheel hp

SPEEDS

Gear Range	Speed mph
Low	0–3.0
High	0–7.5
Reverse	0–5.5

New True-Dimension track

New in design, heavier and stronger . . . plus new advances in wearability. New heat-treating methods permit achieving optimum hardness throughout the track sidebar for maximum wearability and toughness . . . longer life, more time on the job.



New, heavy straddle-mounted final drives

Provide ample strength for today's bigger mounted equipment, bigger loads. And the HD-21's entire final drive assembly rides in a rigid, one-piece steel case, with *all* gears straddle-mounted on tapered roller bearings to insure better performance, longer life.

A host of new features

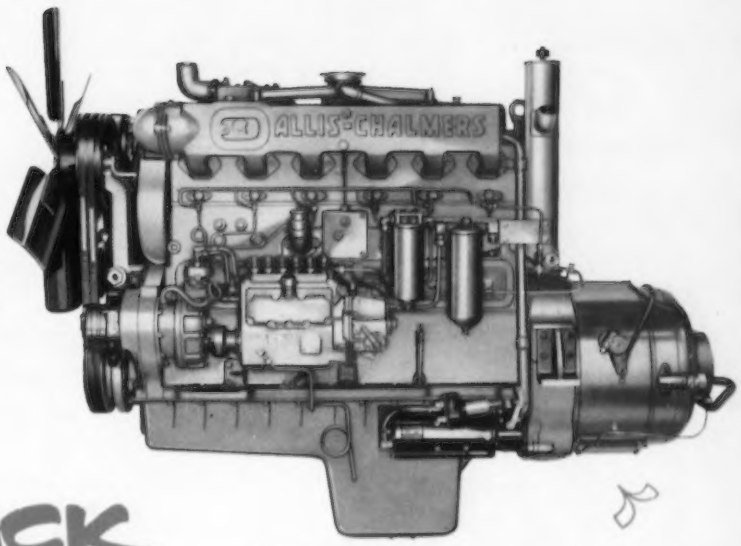
Heavyweight front idlers and truck wh
high-capacity cooling system . . . separ
exchanger for torque converter . . . str
main frame . . . heavy-duty 135-gal fu
foam rubber seats and arm rests . . . n

o o in the amount of work they do!

Allis-Chalmers engine

Brings you top performance, extra-long life through a new kind of "follow-through" combustion. Here's why—

The key explosion occurs in the energy cell as shown, unleashing a blast that sets up cyclone turbulence. Result—no damaging peak pressures . . . instead, higher average and sustained working pressures and more effective leverage on the crankshaft. *Be sure to ask your Allis-Chalmers dealer for the visual story revealing the full advantages of this new engine.*



CK TO STACK

ers!

Great new engine-torque converter-transmission team

The new Allis-Chalmers engine's characteristics combine with the HD-21 torque converter to produce a new kind of high-output performance. Combined with a new transmission, it brings you closer to complete elimination of shifting than ever thought possible.

The HD-21 will do *20 percent more work* . . . give you lower cost per unit of work and higher profit. And your operators will never have it so easy!

ALLIS-CHALMERS
HD-21
DIESEL TRACTOR

nted
ire

ures
truck wheels . . .
. . . separate heat
er . . . stress-relieved
35-gal fuel tank . . .
ests . . . many others.

o!

The new HD-21 and TS-360 are

BACKED BY ALLIS-CHALMERS DEALER SERVICE PLAN

Yes, your Allis-Chalmers dealer offers you original factory parts for both the HD-21 and TS-360 . . . plus a *planned* approach to service, right from the day equipment is delivered. It covers factory service schools, in-the-field lubrication schedules, operating tips and preventive maintenance.

You owe it to yourself to take full advantage of the Allis-Chalmers Dealer Service Plan to keep your equipment operating efficiently. Experience *proves* that it pays big dividends.

FIELD UNITS TO SPAN THE NATION

Specially-equipped trucks from the Allis-Chalmers Training Center, Springfield, Illinois, are on their way to the field *now*, as a special service backing up the introduction of the HD-21 and TS-360. First trips will bring factory specialists to locations all over the country to present the story on these great new dirt movers and their service advantages.

For all the facts on when one of the Field Units will be in your vicinity . . . plus full information on planned service, see your nearby Allis-Chalmers dealer.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

MS661-5503

Printed in U. S. A.

NEW *Run-of-Mine* SCALPING SCREEN

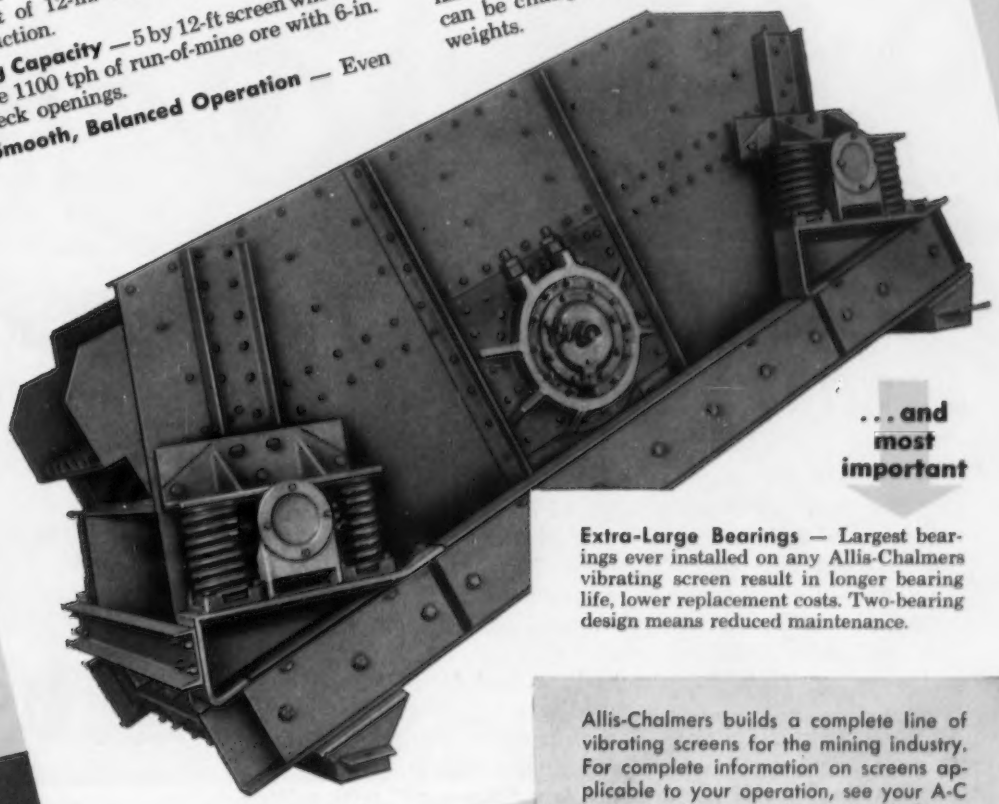
Now — a new extra heavy duty screen developed by Allis-Chalmers for run-of-mine scalping!

Sturdy Construction — Large pieces of ore weighing 4000 to 8000 lb can be handled on screen without transmitting shock loads to the bearings. Deck support is built of 12-in. I-beam and channel construction.

Big Capacity — 5 by 12-ft screen will handle 1100 tph of run-of-mine ore with 6-in. deck openings.

Smooth, Balanced Operation — Even hundreds of pounds of sticky material adhering to screen body will not throw screen out of balance. Reports show it is not necessary to shut down screen to remove adhering material. Soft spring mountings practically eliminate vibration transmission to building.

Cartridge Mechanism Speeds Removal — Entire mechanism can be pulled out of screen after removing sheave and four bolts. Bearings can be replaced and mechanism installed easily and quickly. Throw can be changed by adding or removing weights.



. . . and most important

Extra-Large Bearings — Largest bearings ever installed on any Allis-Chalmers vibrating screen result in longer bearing life, lower replacement costs. Two-bearing design means reduced maintenance.

Allis-Chalmers builds a complete line of vibrating screens for the mining industry. For complete information on screens applicable to your operation, see your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-4595

Reduce the Cost of Ore Reduction

WITH TRAYLOR TYPE H JAW CRUSHERS

For operating economy you can't beat a Type H Crusher.

The real payoff with Type H operation comes from the efficiency of Traylor's curved jaw plates. This original Traylor development has tripled jaw plate life over that of the conventional straight plates . . . reduced power requirements amazingly and practically eliminated choking and packing in the crushing chamber.

They are efficient . . . rugged . . . and dependable. Welded steel plate frame . . . simplified swing jaw suspension . . . sturdy cast steel pitman . . . provide trouble-free operation to cope with the heaviest production schedule.

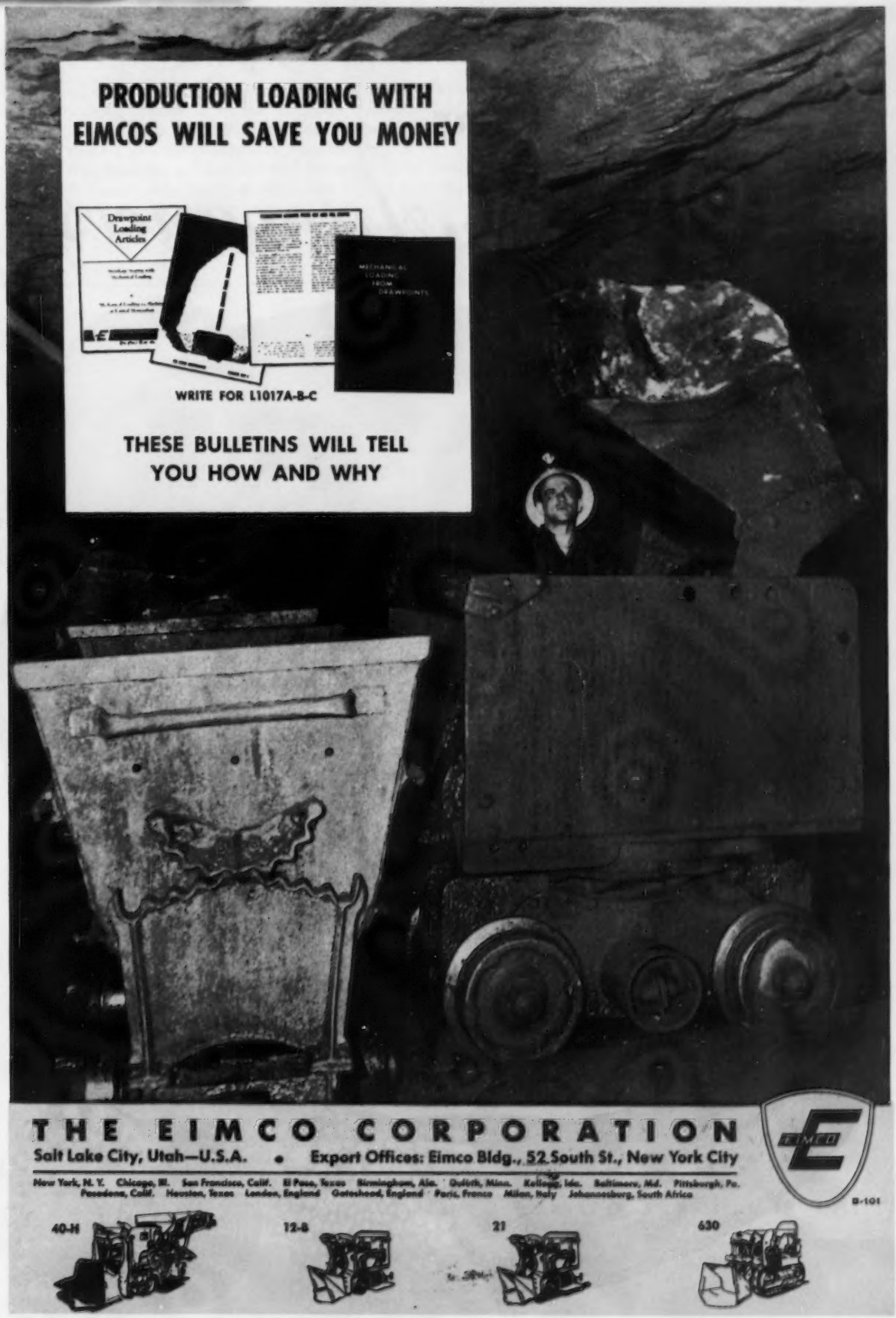
Traylor Type H performance is a "buy-word" with mining men throughout the world. Send for Traylor Bulletin #5105 and see why.

TRAYLOR ENGINEERING & MFG. CO.
752 Mill St., Allentown, Pa.
Canadian Mfrs.: Canadian Vickers, Ltd., Montreal, P. Q.

A Traylor leads to greater profits

SEND FOR BULLETINS
. . . just mention the Traylor Equipment that interests you.

SALES OFFICES · NEW YORK · CHICAGO · SAN FRANCISCO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EIMCOS WILL SAVE YOU MONEY
Drawpoint Loading Articles
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WRITE FOR L1017A-B-C
THESE BULLETINS WILL TELL
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B-101
40-H
12-B
21
630

HAZARD WIRE ROPE

Proudly Announces

LAY-SET

VHS

A NEW WIRE ROPE OF

Very High Strength

Developed for the TOUGHEST JOBS

Until very recently, certain confidential military applications have consumed almost all of our available production of LAY-SET VHS. However, since World War II a limited amount has been field tested in certain specific commercial applications.

Now you can get LAY-SET VHS for seven major uses—for scrapers, bull-dozers, drag lines, shovel hoist ropes, logging arch lines and chokers, rotary drilling lines and slushers. These applications are among the toughest wire rope has to meet. The unusual demands they make on wire rope dictate the use of VHS.

Costs Less to Use

Because it lasts longer and cuts "down time" for replacement, VHS wire rope costs less to use. It increases work output. Since it is stronger and tougher, it reduces the footage of rope you need to buy to operate your equipment.

Carefully kept service records on actual field tests in the applications mentioned above prove the greater economy of LAY-SET VHS.

At Least 15% Stronger than Other Grades

VHS is a new grade of steel for wire ropes. It is at least 15% stronger than Improved Plow Steel, which up to now, has been the strongest standard grade of wire rope manufactured.

This means that in some applications you may be able to use smaller lines to carry the same load. In other applications you may be able to carry heavier loads with lines of the same size.

Tougher Rope for Longer Life

In addition to being stronger, the new VHS wire is tougher and more wear-resistant. It offers greater resistance to abrasion. It keeps its shape under pressure . . . can't become "hide bound" or lose its flexibility.

This extra toughness and wear-resistance means longer service life . . . and less "down time" of equipment for rope replacement.

Biggest Improvement Since LAY-SET Preformed

LAY-SET VHS is the greatest improvement in wire rope since ACCO introduced Preformed over thirty years ago. It combines greater strength and toughness with all the advantages of Preformed construction. As proven in actual field tests, it lasts longer and does more work with less "down time" for replacement.

Find out how you can reduce service costs by using LAY-SET VHS on all of the applications mentioned above.

See your Hazard distributor or write to the nearest office listed below for brochure **DH-490.**

HAZARD WIRE ROPE DIVISION
American Chain & Cable Company, Inc.

Wilkes-Barre, Pa., Atlanta, Chicago, Denver, Houston, Los Angeles, New York, Odessa, Tex., Philadelphia, Pittsburgh, Portland, Ore., San Francisco, Bridgeport, Conn.

Prominent in the Uranium Mining Picture

Gardner-Denver Equipment

PROSPECTING AND TESTING—with Deep Hole Drilling Equipment and Dual-Pressure Compressor on truck-mounted rig.

SURFACE DRILLING—with lightweight, easily maneuvered Gardner-Denver Wagon Drills. Stripping open pit mine.

ACCESS ROAD BUILDING—with Gardner-Denver Water-Cooled Portable Compressor and S48 Sinker.

ADIT AND UNDERGROUND DRILLING—with the lightweight Gardner-Denver Model FL48 Air Feed Leg Drill.

Write for further information.

GARDNER-DENVER Since 1859

KELLER TOOLS

GARDNER-DENVER

THE QUALITY LEADER IN COMPRESSORS, PUMPS AND ROCK DRILLS FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd.,
14 Curity Avenue, Toronto 16, Ontario

1 high-speed, rubber-tired tractor replaces 2 crawlers

for North American's Catskill Plant

◀ Tournatractor speeds from job-to-job at 19 mph. This speed enables one machine to keep up-to-date on all the "housekeeping" jobs that formerly kept two crawler-tractors busy.

Instant-shift, plus reverse speed of 8 mph, enables operator to work in and out around shovel without delays to load cycles. Electrical-control down-pressure permits smooth cleanup of the rocky floor. ▶

North American Cement Corporation quarries about 2,000 tons of limestone daily at their Catskill Plant near Alsen, New York. To handle shovel cleanup and other tractor work, they brought in a 19 mph Tournatractor to replace 2 crawlers.

All-around handyman

Tournatractor's main task involves cleaning the pit floor around the shovel, and dozing rocks and material back to the toe after the face is shot. The versatile unit also removes dirt wash from the top of the bank, cleans up truck spillage on haul roads, and hauls cable to drilling rigs. It also cuts new haul roads and clears overburden of trees and brush. Not only has Tournatractor proved far faster than the crawlers it replaced, but its big tires roll easily over the sharp-edged rock fragments which caused excessive track wear and breakage.

Says Foreman John Nickolitch, "For quarry use, Tournatractor is ideal."

"You don't get the bounce on this work you do with a crawler," adds Operator George Wagner. "Also, you have better control of your blade."

Tournatractor's fast working speeds on rubber can pay off in increased production and lower maintenance costs for you, too. Ask for a demonstration of Tournatractor on your job. Judge its advantages for yourself.

Recently, Westinghouse Air Brake Company purchased from R. G. LeTourneau, Inc. their earthmoving and related products together with their Peoria, Toccoa, and Australian factories. Adding the high quality standards, precision manufacturing experience, and research facilities of Westinghouse Air Brake to the earthmoving developments of LeTourneau, gives you assurance that the improved line of equipment offered by this strong new company is the finest on the market. Be sure to check LeTourneau-Westinghouse before you buy.

Tournatractor—Trademark T-609-Q-b

A Subsidiary of Westinghouse Air Brake Company

LeTourneau-Westinghouse Company

PEORIA, ILLINOIS

NEW 35 ton Rear-Dump

Model B Tournapull Rear-Dump is a new machine completely designed and built by the new LeTourneau-Westinghouse Company. Developed by our engineering and research staff, it was built after careful study of today's hauling unit requirements. Its design is based on eight years of experience with our revolutionary rear-dump units.

Hundreds of these earlier units are at work today . . . in mines, quarries, collieries, construction jobs . . . anywhere that material is being hauled by modern methods and modern equipment. They have been highly successful, as proved by our list of re-orders from old customers.

In the new machine, the Model B prime-mover powering the B Rear-Dump is a big powerful tractor engineered for quick and easy accessibility of all components. Every part has a "plus" safety factor to give you the most rugged hauling unit ever built. Dozens of improvements, large and small, give you a hauler that does the job better than any Rear-Dump ever produced.

10 forward gear speeds: 2, 4, 6, 8, 11, 16, 19, 24, 28, 34 mph . . . 2 reverse speeds: 2, 4 mph.

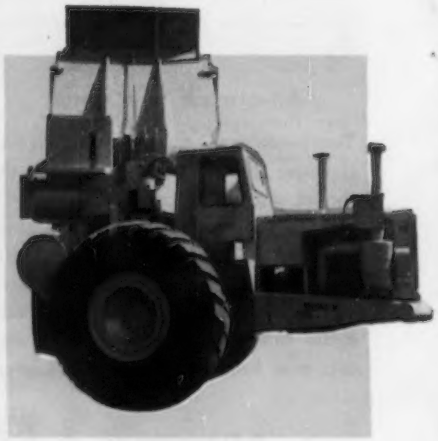
Check these features:

High speed matched to haul conditions

Tournapull B Rear-Dump has 10 forward speeds to 34 mph. Operator easily selects gear which gives him top speed. Double-clutching has been eliminated by addition of clutch brake for faster, easier shifting. Rapid shift and snappy acceleration of 300 hp diesel engine lets you move rapidly into higher gear ranges.

Improved gradability

Better distribution of weight forward onto drive wheels allows "B" to go up steeper grades than previous models could. This improvement, plus selection from 10 forward speeds, plus ample horsepower gives you a unit that can climb at reasonable speed up any grade normally found on any mine, quarry, or construction job.



LeT

A Subsidiary of
Westinghouse Air Brake Company

Non-stop U-turns in 35′

2-wheel prime-mover turns 90° right or left . . . machine in normal use makes non-stop 180° turn in space only 35′ wide. With bowl raised (which shortens wheelbase from 21′ to 12½′), "B" turns around non-stop in space only 27′ wide. This extreme maneuverability enables you to work in tight quarters where smaller conventional haulers often cannot go. You save time on any job at both shovel and dump because Tournapull can position faster . . . rarely needs to jockey back and forth like conventional haulers.

Easy loading

Big wide "target" area makes for fast loading cycles. Bowl is 7′8″ long, 10′2″ wide, has maximum depth of 7′6″. Rear of body provides wide, low entry for dipper to give extra speed advantage for the excavator. Low entry, plus wide body, reduces spillage. Rig carries 35 tons, 23 yards struck, 27 yards on 2-to-1 heap, without sideboards.

Fast dumping

Body raises to vertical position at touch of dashboard switch. Inside of body is completely streamlined. No material rides back to shovel or dragline to steal payload room on next trip. Edge of bowl swings behind and below rear wheels so rocks cannot roll forward to lodge against wheels nor can material pile under rear end.

Better flotation

Low-pressure tires more than 2 ft. wide and 7 ft. high, both front and rear, give excellent flotation. You get better traction than with other rubber-tired haulers because these broad pneumatics, with their low pressures and thick, deep lugs, have more gripping surface than duals. These features, plus power-transfer differential and power steer, take Tournapull through soft going *loaded* where other haulers with their narrow tires cannot go empty. Unit uses four 27.00 x 33's, 30 ply, as standard . . . tires *and* wheels are interchangeable between front and rear.

Rugged construction

Body is heavy steel plate, rigidly reinforced with box-beam ribs. Gussets are included for extra support at points of special stress. Slanting surfaces of scoop-shaped body take blows at an angle and tend to quickly establish a load cushion to protect the floor. Bottom consists of 2 layers of heavy steel plate separated by thick steel billets to absorb loading shocks. Floor is faced with welded-on tool-steel strips to resist wear. Main case of prime-mover is built extra strong . . . will not distort to put strain on power-train.

Simple, positive electric control

Fingertip electric control of hoist and steer gives fast, positive action. Big advantage of electricity is that motors can be placed at point of action . . . there's far less power loss than with other control systems . . . no leakage or pressure problems . . . less maintenance. Push-buttons on dashboard operate dump at touch of fingertip.

Lower maintenance

Problems of conventional rear-dumps are eliminated by simple design of B Tournapull Rear-Dump. You have no troublesome hydraulics, no long driveshafts, no springs, spring hangers, no hinged steering-connections. Owners all over the world report exceptionally high mechanical efficiency and low maintenance.

Greater safety

Heavy-duty air brakes provide a total of 7536 sq. in. total braking surface. That's more braking surface on each wheel than most haulers have on the whole machine. Smooth and powerful, they provide safe control in any weather . . . improve maneuverability . . . give operator confidence for faster operation on steep grades, narrow, winding haul roads. Optional electro-

tarder that puts an electrical resistance on generator power circuit provides additional braking action and saves wear on service brakes. Parking brake locks transmission output shaft for simple, sure braking action.

Job-proved prime-mover

17 years' experience on thousands of installations is behind the famous Tournapull 2-wheel prime-mover. Its design gives you power steering through geared kingpin coupling prime-mover and hauling unit. You also get the exclusive Tournapull power-transfer differential which automatically transfers power from slipping drive wheel to drive wheel on firmest footing.

Profit-making interchangeability

You can interchange Rear-Dump with Scraper, Bottom-Dump, Flatbed, or Crane. Each additional trailing unit costs only about 25% of original total price. You save money because all you need buy is trailing unit body . . . rear wheels, tires, and brakes may be interchanged.

You'll want to learn more about all the advantages of the remarkable new Model B Tournapull Rear-Dump. Ask your LeTourneau-Westinghouse Distributor for all the details.

Tournapull—Trademark Reg. U.S. Pat. Off. BR-754-G

LeTourneau-Westinghouse Company

PEORIA, ILLINOIS

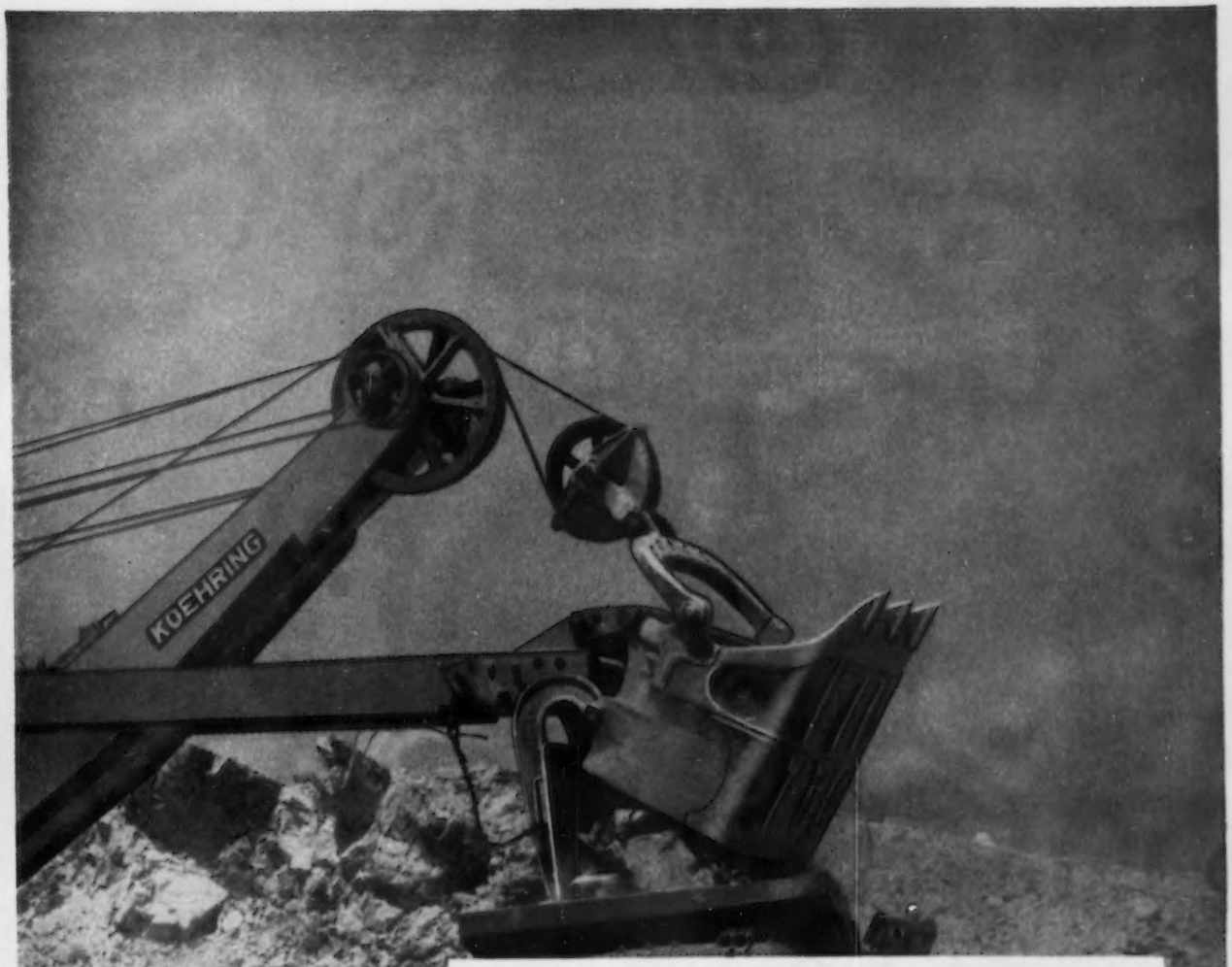
Measure excavators

by price per pound of lifting capacity

In analyzing shovel operation, you will find that price per pound of lifting capacity on crane rating is also an excellent measurement of excavator value. Remember, lift capacity is *work capacity*. Obviously, the machine with the heaviest lift rating not only picks up larger crane loads — it also has more strength, speed and stability to handle bigger loads faster with every excavator attachment.

Check Koehring lift ratings shown on the next page — then ask your Koehring distributor to give you the figures on price per pound of lifting capacity.

KOEHRING COMPANY Milwaukee 16, Wis. Subsidiaries: JOHNSON PARSONS • KWIK-MIX



COMPARE FOR YOURSELF:

KOEHRING MODEL	SIZE DIPPER	KOEHRING LIFT CAPACITIES (Crawler ratings based on 75% of tipping load. Rubber-tired machines — 85% of tipping load)		PRICE PER POUND OF LIFT CAPACITY*
205 CRAWLER	½-Yd.	20,000 lbs.	30-foot boom at 10-ft. radius	?
205 ON RUBBER	½-Yd.	30,000 lbs.	25-foot boom at 12-ft. radius	?
304 CRAWLER	¾-Yd.	27,800 lbs.	35-foot boom at 12-ft. radius	?
304 ON RUBBER	¾-Yd.	50,000 lbs.	30-foot boom at 10-ft. radius	?
405 CRAWLER	1-Yd.	40,000 lbs.	40-foot boom at 12-ft. radius	?
605 CRAWLER	1½-Yds.	72,300 lbs.	50-foot boom at 12-ft. radius	?
1005 CRAWLER	2½-Yds.	159,000 lbs.	50-foot boom at 12-ft. radius	?

Figures available on request — ask your Koehring distributor for them.

KOEHRING HEAVY DUTY

RIDING RANGE
at Mesabi

In open-pit mining operations throughout the world—where the earth's crust is moved by the millions of tons—there's where you're sure to find hard-working Mack trucks.

The Mesabi Iron Range of Upper Minnesota is no exception. At various mining properties you can see more than 200 big Macks working under the huge shovels. They're taking on every kind of demanding hauling—from removing overburden to lugging out heavy loads of ore from the lowest levels of the pits.

Macks' popularity in demanding iron mine service has been won by their ability to handle efficiently the heaviest loads under all conditions and to stay on the job . . . day after day and night after night.

3020

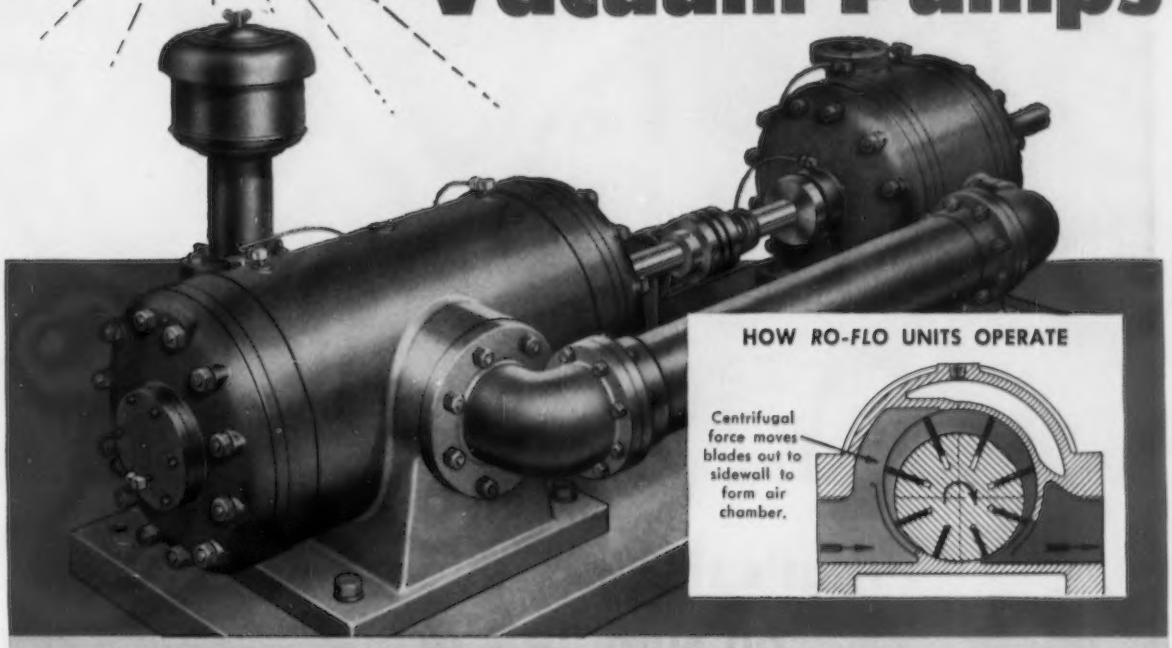
MACK TRUCKS, Empire State Building, New York 1, N. Y.

ALLIS-CHALMERS

NEW

100-lb Compressors

0.3-in. Mercury Absolute Vacuum Pumps



FOR SHOP AIR • DRILLING • GAS HANDLING • VACUUM PUMPING

Now—the *Ro-Flo* line is extended to include high pressure as well as low pressure units to give you three important advantages:

Constant efficiency —Automatic compensation for wear is inherent in *Ro-Flo* design. During operation, rotor blades slide against the sidewall to form air cells. Any blade wear from this action is compensated for by the rotating force which holds blades in contact with the cylinder.

Simple foundation requirements—The smooth rotation of the *Ro-Flo* unit cuts vibration and eliminates need for heavy, expensive foundations.

Low maintenance — Shock and vibration, inherent in reciprocating machines, is eliminated. This cuts maintenance.

Two-stage *Ro-Flo* compressors can be furnished in any of 12 sizes to handle from approximately 250 to 1800 cfm at pressures from 65 to 125 pounds gauge. Vacuum pumps furnished from 200 to 5040 cfm at 29.7 inches Hg vacuum, with shut-off of 29.9 inches Hg, referred, or better. Single-stage units are built for pressures up to 50 pounds gauge, 65 pounds absolute. Single-stage pumps for vacuums up to 28 inches Hg referred.

A-4569

GET INFORMATION

Call your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

Ro-Flo is an Allis-Chalmers trademark.

ALLIS-CHALMERS

That's the long-life valve on sulphuric acid

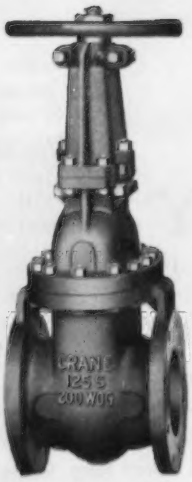
THE CASE HISTORY: At a large midwestern refinery there were recently two valves of different makes on a 90% sulphuric acid line. As seen in the photo above, these valves worked under identical conditions, almost side by side—each operated about three times daily.

Less than a year in the line, the valve at left started leaking, with the leak getting rapidly worse. In contrast, the Crane No. 475½ all-iron gate valve at right, with two years' continuous service to its credit, was still giving completely good performance.

That's Crane quality in valves—with a 100-year background in quality manufacturing. That's why Crane valves are the first choice of thrifty buyers in the petroleum industry as in all others. Crane Co., General Offices, Chicago 5, Ill. Branches and Wholesalers serving all industrial areas.

CRANE IRON BODY WEDGE GATE VALVES

Here are valves of unusual strength for their 200-pound W.O.G. rating. Body and bonnet are oval shaped, with extra metal where needed most. Their Crane-quality cast iron with highly engineered operating design makes these valves outstanding performers wherever they're used. A complete family to choose from. See your Crane Catalog or your Crane Representative.



for the THRIFTY BUYER

CRANE CO.

VALVES • FITTINGS • PIPE
KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY...1855-1955

No long stops to switch drill steels with TIMKEN® interchangeable rock bits

Dozens of different Timken multi-use and carbide insert bits fit the same drill steel!

YOU end costly drilling delays in switching steels when you change to Timken® multi-use and carbide insert bits.

Just unscrew one type of Timken bit and screw another on the same drill steel, right on the job. Makes it easier for the driller to change to the most economical bit as the ground changes. You also eliminate expensive drill steel inventories because dozens of different Timken multi-use and carbide insert bits *are interchangeable on the same steel.*

Both types of Timken bits are made from electric furnace Timken alloy steel, have a special shoulder union that keeps drilling impact from damaging threads.

Our expert rock bit engineers will be happy to help you solve your drilling problems. Just write: The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO".

WHERE YOU CUT COSTS WITH TIMKEN MULTI-USE BITS

Most economical for ordinary ground. With correct and controlled reconditioning, they give lowest cost per foot of hole when full increments of steel can be drilled.

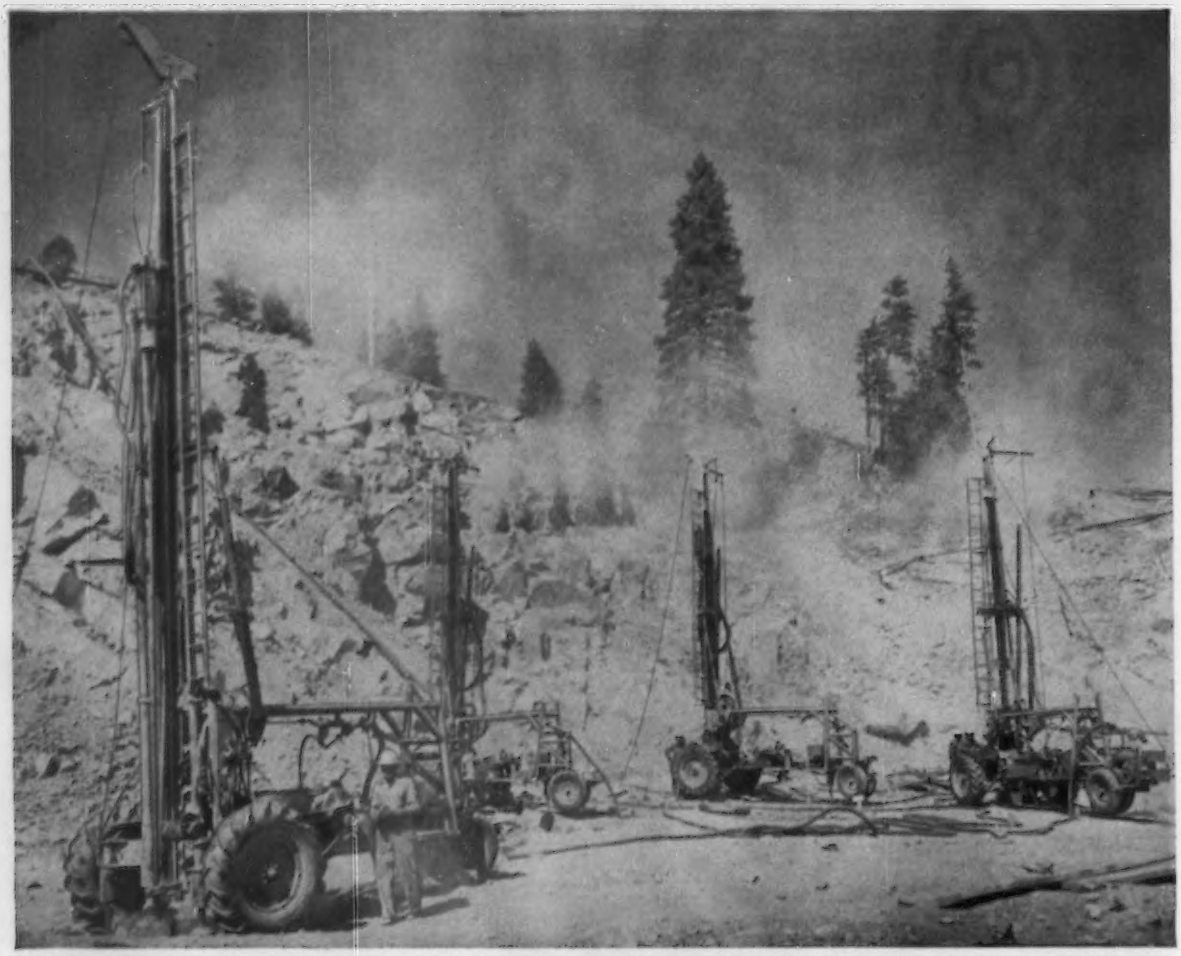
WHERE YOU CUT COSTS WITH TIMKEN CARBIDE INSERT BITS

Give highest speed through hard, abrasive ground. Also most economical for constant-gauge holes, small-diameter holes, very deep holes.

TIMKEN

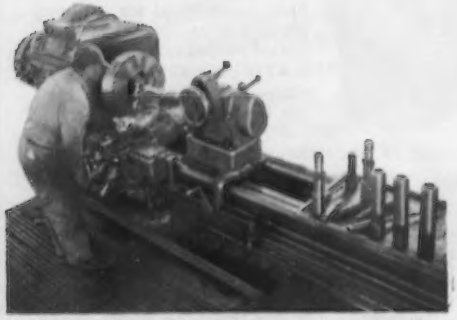
TRADE-MARK REG. U. S. PAT. OFF.

... your best bet for the best bit ... for every job



Crucible hollow drill steel at work on site of new Cherry Valley Dam.

A BIG BITE... 1½-million yards of hard granite



Machining a shank adaptor of Crucible Max-el 3½ alloy steel, for use on Joy Challenger drill.

That's the amount of hard rock the Guy F. Atkinson Company has now drilled through in constructing the new Cherry Valley Dam near Sonora, California.

For this tough job, two-inch round Crucible *Crusca* hollow drill steel is being used in eight big Joy *Challenger* drills.

As on so many other big jobs, Crucible drill rods were chosen because experienced construction men *know* they can depend upon them for *lowest cost per foot of hole drilled* — even under the most rugged conditions. And with good reason. For Crucible hollow drill steels are made to *tool steel* standards, by the country's leading producer of tool and other special purpose steels.

Choose them for your next job. You'll get top drilling efficiency, at lowest cost. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

E&MJ NEW PRODUCTS DIGEST

WEMCO TORQUE-FLOW PUMP

A completely new concept of pumping leaves the pump housing entirely open. Rotating fluid (induced by impeller) forms the carrying medium. Nothing to jam, clog, break or bind.

CONVENTIONAL CENTRIFUGAL PUMP

All present day centrifugal pumps require material to follow relatively narrow passages from center feed to periphery of the rotating impeller. Result: jamming, clogging, breaking, binding.

ENTIRELY OUT OF PULP PATH torque producing impeller in the Wemco Torque-Flow solids pump leaves an open passage with nothing to impede free flow. The company says most of the particles are discharged in less than one revolution due to centrifugal force induced by the swirling vortex action of the fluid mass. They also say that the vortex extends into the feed line and draws particles into the moving stream not unlike the waterspout of a tropical hurricane.

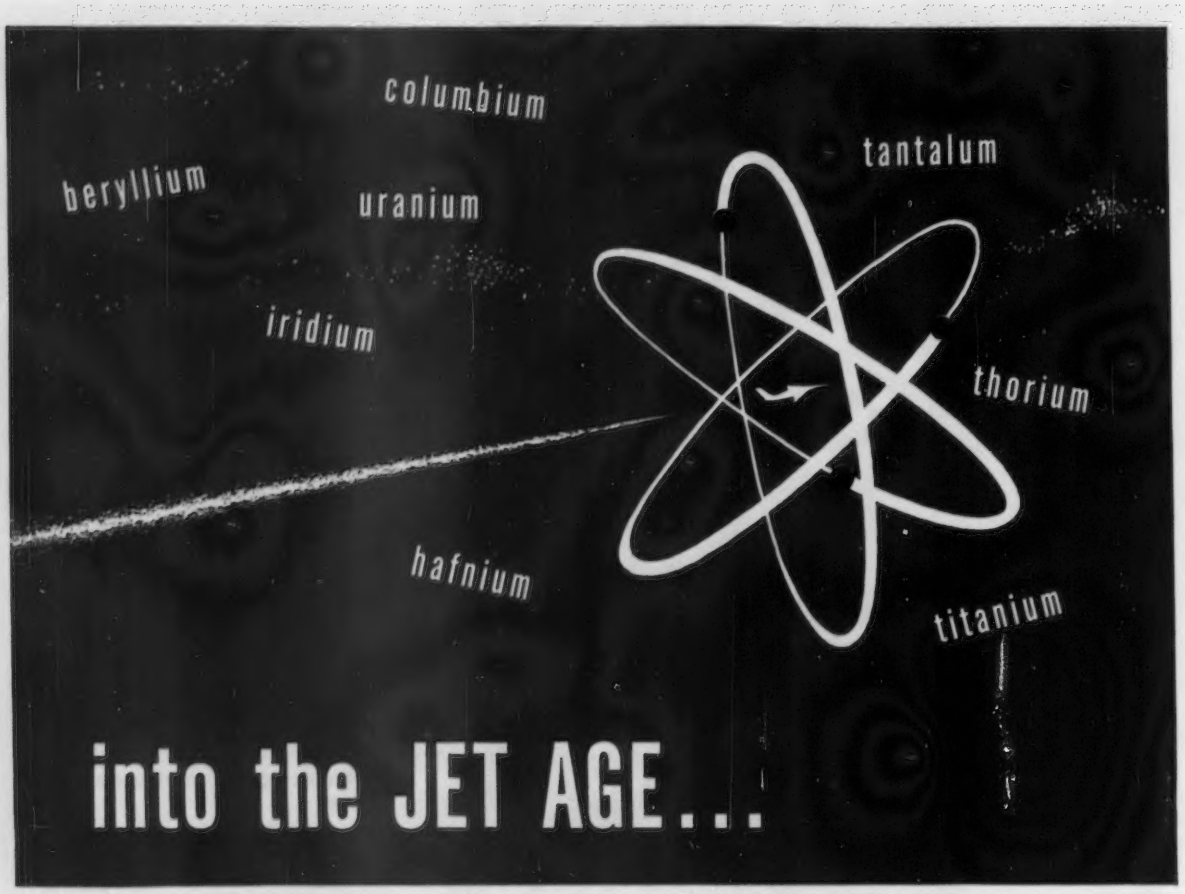
Wemco's New Concept in Pumping Solids

Suspended particles handled by Wemco's Torque-Flow solids pump do not touch the impeller during operation, according to the manufacturer's release. The impeller is entirely out of the pulp path leaving nothing to impede free flow.

Field tested extensively, the pump has moved everything from live fish to ready mix concrete. Western Machinery Co., San Francisco 7, Calif., the manufacturer, recommends it use for all abrasive, soft, or friable materials, sewage and other waste as well as fibrous materials.

It is a unique concept of pumping resembling the principle of the automotive fluid-torque-converter. The rotating impeller, recessed in the casing, develops a swirling vortex of incoming fluid mass. The vortex extends into the feed line and sucks particles into the moving stream. As the particles swirl into the fast moving vortex within the pump housing they are accelerated and the centrifugal force induced forces them out of the discharge line. The rotating fluid mass is claimed to form a buffer between the suspended material and the impeller. Thus, wear is minimized. The non-clogging, non-jamming, non-binding and non-breakable aspects of the revolutionary design are also emphasized by Wemco, the manufacturer.

Among the other design features, are provisions for quick disassembly, complete or partial, from either intake end or discharge end without disturbing piping. In addition, there are no wear rings or necessity for lateral adjustment of impeller shaft to compensate for wear. The pumps are built in sizes from 2 to 10 in. for flows up to 3900 gpm at 80-ft head. They can be furnished with mechanical seals and can be built in a choice of materials including Ni-Hard or other abrasion-resistant steels, stainless steel, bronze and other special alloys. **(1)**



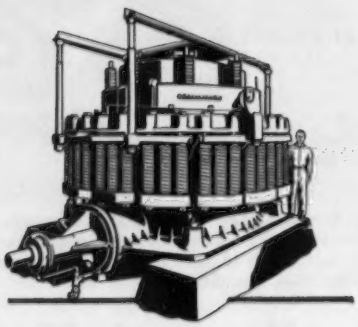
Rarer Elements now serve the Men of Science

☆ As man crashes through the sound barrier, we find new words being used to describe the miracles wrought by today's men of science and research . . . words like *electronics—guided missiles—nuclear fission—transistors.*

Helping to make these scientific advances possible are the technical skills and vast experience of the mining industry, now being utilized to develop the rarer elements. Rocks and minerals formerly of no commercial interest have thus come into production . . . including *aplite, nepheline, syenite, olivine, perlite, pinite, topaz,* and many more.

Uses of these elements are numerous—ranging from modern construction to radar, sonar, and jet aircraft parts . . . but most of them have one thing in common . . . they are being processed by SYMONS® Cone Crushers—*the machines that revolutionized crushing practice.*

NORDBERG MFG. CO., MILWAUKEE, WIS.



SYMONS Cone Crushers are built in Standard, Short Head, and Intermediate types, with crushing heads from 22 inches to 7 feet in diameter—in capacities from 6 to 900 tons per hour.

SYMONS . . . A REGISTERED NORDBERG TRADEMARK KNOWN THROUGHOUT THE WORLD

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NORDBERG MACHINERY — NORDBERG — SYMONS SCREENS NORDBERG

MACHINERY FOR PROCESSING ORES and INDUSTRIAL MINERALS

NEW YORK • SAN FRANCISCO • DULUTH • WASHINGTON
TORONTO • MEXICO, D.F. • LONDON • JOHANNESBURG

Symons Gyratory Crushers

Grinding Mills

Mine Hoists

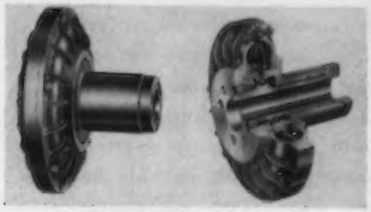
Symons Vibrating Grizzlies and Screens

Diesel Engines

E&MJ NEW PRODUCTS DIGEST

SAVES LOADING TIME

Production of a "King-Size" dynamite cartridge has been accomplished, says Hercules Powder Co., Wilmington, Del. The loading-time-and-labor-saving product required the design of a new machine for packing the small diameter, long length sticks. They are available in 12-, 16-, 20-, and 24-in. lengths and 1¼-, 1½-, 1¾- and 2-in. diameters. **(2)**



DRY FLUID DRIVE

Compact, simple drive or coupling especially designed for reversing, shock, or heavy inertia loads has just been introduced by Dodge Mfg. Co., Mishawaka, Ind. Based on a European developed principle the Flexidyne drive is made up of a hollow disk-like housing, inside of which a wavy-plate rotor is free to turn concentrically. Between the two are fine particles of a spherical steel shot, called the "flow charge," which acts very much like a fluid and which transmits power from the housing to the rotor. **(3)**

MAKES BETTER ROADS

Rubarite asphalt additive results in longer life, says Rubarite Inc., Chicago 4, Ill. The most important effect of the addition is the decreased degree of property variation with temperature change. Rubarite No. 1 is a free flowing mixture of finely divided particles consisting of 25% unvulcanized synthetic rubber and 75% barytes. Developed for roadways, it increases impact resistance and ductility. **(4)**

Dry drilling and dust . . .

LEASE TO BUY OR NOT

Their lease plan for new TerraTrac crawler tractors and equipment is believed to be an innovation in the equipment industry by American Tractor Corp., Ft. Wayne, Ind. The plan calls for as little as 10% cash down and a lease with or without an option to buy. It also features reduced payments during emergency periods. The manufacturer endorses the financing through local banks rather than have company or dealer financing like other "limited" lease plans. It is aimed at smaller firms that do not want to tie up major capital. **(5)**

WIDER RANGE

Three additional models, 1 in., 1¼ in., and 1½ in., enlarge the range of the Type L centrifugal pump first developed in a 2 in. unit by Dorr-Oliver Inc., Stamford, Conn. Major advantage of the corrosion resistant chemical pump is claimed to be the high-cut-water or "tongue" of the volute which makes the unit self-venting and minimizes formation of air pockets. Same feature makes for easy priming and better maintenance of prime in operation. They are particularly adapted to vacuum filter and evaporator applications. **(6)**

NO WATER, YET NO DUST

Faster, cheaper, waterless drilling is promised by Kadco Corp., L. I. City 6, N. Y., for users of their rock drill dust collector. Sucks chips and dust into hood on drill steel—hose hookup to 200 ft or more—collects in baffle chamber and filter bags—4 hr between emptying—for 4 jackhammers or 2 wagon drills—gasoline, diesel, or electric power. **(7)**

plus hood, hose and collector . . .

IMPROVED SCREEN HEATER

Now it consumes half the power of comparatively operated equipment says the Deister Concentrator Co., Ft. Wayne, Ind., about its improved electrical heater, FlexElex, for the screen cloth in the Leahy vibrating screen. Because power consumption of heated screens is so high, the company claims this as an important advance. **(8)**

TUBELESS RIM

Tru-Seal air locking rim solves the problem of adapting the tubeless tire to trucks and giant earth movers. An exclusive development of Goodyear Tire & Rubber Co., Akron 16, Ohio, the problem had puzzled the entire industry. The new three piece metal rim with small rubber ring simplifies tire mounting as well. No tools are needed, it is claimed. Together with Goodyear's tubeless truck tires the Tru-Seal rim weighs less than the conventional combination. It fits all present dimensions. **(9)**

TAILORED TO FIT

Tailored torque converters for any engine at lower prices is one of the latest offerings of the Borg-Warner Corp., Long Mfg. Div., Detroit, Mich. Usefulness in reducing hp requirements for overcoming starting loads and other savings are known. Matching converter to engine is new, as is availability of tailshaft governor which maintains desired speed automatically. For winches and excavating equipment especially. **(10)**

equals dustless drilling.

MILLIONS OF YARDS

2 MANITOWOC 4500's strip 3½ million yards of overburden per year for Hart and Hart, Providence, Ky.

It takes plenty of mechanical muscle to move millions of yards of tough overburden — 95% of which was rugged rock and shale!

These two big Manitowocs — a 4500 high-lift 5½ yd. shovel and a 4500 Dragline with 100′ boom — powered their way through 80′ of this rough going 24 hours a day, six days a week, all year long. Between them, these big workers uncovered over 478,000 tons of coal!

In addition to tremendous power, Manitowocs have the fast travelling speeds, the maneuverability, the operating speeds, and the stamina it takes to turn out big production on even the toughest jobs. These outstanding features — plus a minimum of down-time — mean profitable operation on every job! Get all the facts on Manitowoc. Manitowoc Engineering Corp., Manitowoc, Wis.

MANITOWOC
SHOVELS 1-5 YD. Speedcrane CRANES 20-100 TON

DAY IN, DAY OUT

Seeing a proven need for easily portable electric generating units, Caterpillar Tractor Co., Peoria, Ill., has come out with a series of 10 mobile and skid mounted diesel powered sets. For continuous non-stop duty, the four trailer units put out 155 to 300 kv in eight different voltages at 50 to 60 cycles. Five smaller skid mounted sets give 18 to 116 kw, and a special totally enclosed small trailer model gives 150 kw. The prototype of the large trailer sets has performed yeoman duty in emergencies throughout the country. **(11)**

WIRE ROPE ADVANCE

Royal Blue, a 15% stronger wire rope that lives longer, is Roebling's latest contribution to the industry. Obstacles to rope of greater strength have been broached according to John A. Roebling's Sons Corp., Trenton 2, N. J. The result gives higher resistance to wear from bending and abrasion as well as higher strength than the strongest grade marketed heretofore. The new line of wire rope has a steel core, is manufactured primarily in preformed constructions, and is obtainable in ¼ to 3½ in. sizes. Those industries that use a wire rope with an independent wire rope core will benefit, says the maker. Slushers, churn drills, draglines and shovels are a few of the applications. **(12)**

HAZARDLESS CAR COUPLER

Male link self-centers to eliminate hand labor on the Mayo automatic coupler for small mine cars. The female mate has wide guides for coupling on curves—disengages by lifting eye. A 2-in. slack permits gradual starts. It is easily attached. Mayo Tunnel & Mine Equipment, Lancaster, Pa. **(13)**

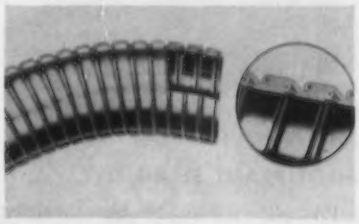
STOPS SEEPAGE

A thin film of Permagile applied once to an interior wall will form a permanent water barrier according to the Permagile Corp. of America, L. I. City 1, N.Y. A recently introduced paste which turns into a hard mineral-like substance when acted on by a setting agent, it can be applied by a trowel and most of the usual methods. Cracks can be filled as well, and the strength of the joint is claimed to be greater than the material joined. **(14)**

A DREAM

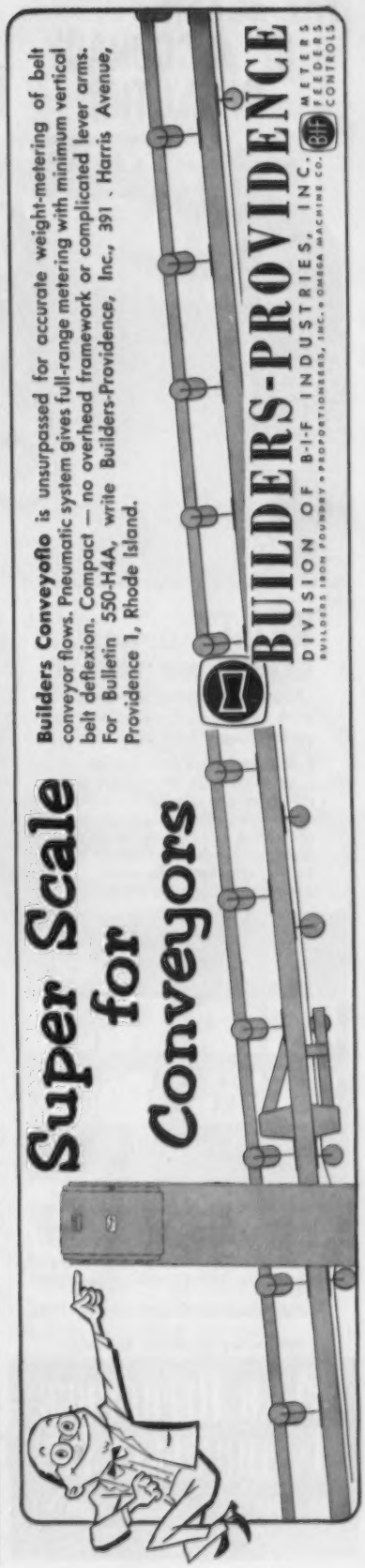
Better coordination by means of the electronic control of all operating functions is one of the innovations on the P&H Model 1800 electric shovel, latest

and largest made by Harnischfeger Corp., Electric Shovel Div., Milwaukee 46, Wisc. The heavy duty mining machine has an 8-cu yd capacity and features the "Magnetorque" electromagnetic type coupling for the hoist drive. It is reported that the simple, reliable electronic controls can be maintained and understood by the average electrician. **(15)**



WHIPS WEAR

For conveying abrasive and corrosive materials, the flexible metal hose by Universal Metal Hose Co., Chicago 23, Ill., is a new offering. In two weights—Type U-100-L, standard, and Type U-120-L, heavy duty—it has a stainless steel or carbon steel liner—six inside diameters, 3 to 8 in., others by special order. **(16)**

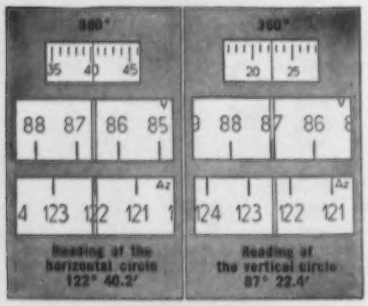

Super Scale
for
Conveyors
Builders Conveyoflo is unsurpassed for accurate weight-metering of belt conveyor flows. Pneumatic system gives full-range metering with minimum vertical belt deflexion. Compact — no overhead framework or complicated lever arms. For Bulletin 550-H4A, write Builders-Providence, Inc., 391 Harris Avenue, Providence 1, Rhode Island.
BUILDERS-PROVIDENCE
DIVISION OF B-I-F INDUSTRIES, INC.
METERS
FEEDERS
CONTROLS

THE ACME OF ACCURACY IN ACTION

WILD T-1 OPTICAL *REPEATING* TRANSIT

Rugged, compact design... with 20 years of proven service under tough field conditions.

Both circles read from one single position through microscope alongside telescope eyepiece. Optical micrometer eliminates possibility of reading error. Illumination is provided by daylight mirror or battery attachment for night, underground or mine work.



WILD surveying instruments, inherently accurate, are Swiss precision designed for stability under adverse conditions, for sturdiness, and for ease in operation . . . they provide lasting trouble-free service.

●

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Full Factory Service by Specialists

WILD HEERBRUGG INSTRUMENTS INC.

MAIN & COVERT STS., PORT WASHINGTON, N. Y.
PORt Washington 7-4843

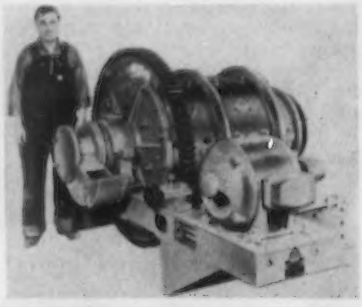
E&MJ NEW PRODUCTS DIGEST

FOR YOU?

Weighing only 50 lb the Demo DL 875S cores ½- to 6-in.-diameter holes up to 100 ft with coupled extensions. Operated by one or two men it uses 8 amp on a 60 cycle or less 110v ac-dc, from a lightweight portable "Gen-A-Matic" Model 17D generator. Air lubricates and clears cuttings on short holes, a minimum of water on deeper ones. The carbide tipped detachable bit strikes 8400 blows per minute and rotates at 350 rpm. Using water the core drill is reported to have drilled a 1½-in. hole in granite at 10 ft per hour. It was developed for use of miners and prospectors by Demo Tool Corp., Los Angeles, Calif. **(17)**

LONG WEARING

Sharpest classification at low cost is claimed for the Krebs cyclones by Equipment Engineers Inc., San Francisco, Calif. Pure gum rubber liner lasts long—steel shells weigh less—4- to 30-in. sizes—single or two stage—adjustable vortex sizes and inlet and apex valves for changing conditions—long sweep inlet and adjustable valve are standard. **(18)**

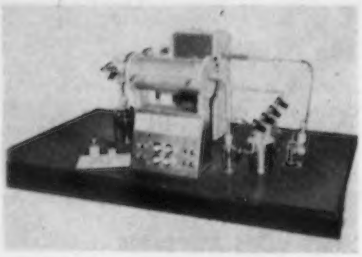


PILOT PLANT FLEXIBILITY

Pilot plant grinding has been simplified with the Denver steel head ball mill recently introduced by Denver Equipment Co., Denver, Colo. This mill mounted on a steel base is designed for flexibility. The shell sections can be added or removed as required to duplicate mill problems accurately. The same base is used whether the mill consists of one or two shell sections. The motor and drive are part of the packaged unit. **(19)**

FOR PRESSURE OR VACUUM

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis., has added a line of nominal 100-lb capacity rotary air compressor-vacuum pumps for shop air system, drill rig, pneumatic conveyor, and similar application. It is water cooled and has a low pressure unit coupled to a high pressure unit on a common bed plate. Eight sizes from 250 to 1800 cfm for pressures from 60 to 125 lb are available. Designed for direct connection to motors, it may be driven through speed reducers or increasers by other drives. **(20)**



LOW COST ANALYSIS

The Oxyator now for sale by Ledoux & Co., Teaneck, N.J., is a laboratory table instrument for determining oxygen in metals. Originally applied to titanium, 9 mo of testing indicate results on many other metals are comparable or superior to other procedures. At the same time the cost for equipment and cost per sample is only about ¼ that of previous methods, according to the maker. It uses the bromination-carbon reduction method, is simple to operate. **(21)**

USES "BUILDING BLOCKS"

Progress Line two-way radio communication equipment is specifically designed to cover the widely divergent needs of the many land mobile radio services. Just announced by the General Electric Co., Syracuse, N.Y., it operates off a 6- or 12-v dc source or 117 ac power without modification of any kind. It uses a vibrator or dynamotor for mobile units and a mobile power source for inexpensive base stations. Utilizing 12 basic "building blocks" of standardized dimensions, great flexibility is provided by their interchangeability and plug-in chassis feature. Maintenance is also simplified. **(22)**

Announcing A **New** TYPE HMS SEPARATORY VESSEL

U. S. and Foreign Patents Pending

Send for Information on Complete Pilot Plant Demonstration and Testing Services

OCC

'OCC' VESSEL INTRODUCES UNPRECEDENTED SIMPLICITY

The new OCC vessel represents the successful realization of the main advantage of the HMS process:—its utter simplicity. The simplicity and efficiency of the OCC vessel are shown by these 6 noteworthy features:—

- **High separating efficiency.**
- **Low operating, maintenance costs.**
- **No rotating parts in the medium.**
- **Open vessel; separation visible.**
- **Quiet pool; no adverse turbulence.**
- **Quickly adjustable rake speed.**

Complete HMS testing, plant designing and installation services.

THE ORE & CHEMICAL CORPORATION

. . . . . *Division: Mining & Milling Machinery* . . . . . .

80 BROAD STREET, NEW YORK 4, N. Y.

KUE-KEN is the lowest price crusher

With its higher operating speeds, Kue-Ken crushes 25% to 50% more rock per inch of jaw width than any other crusher

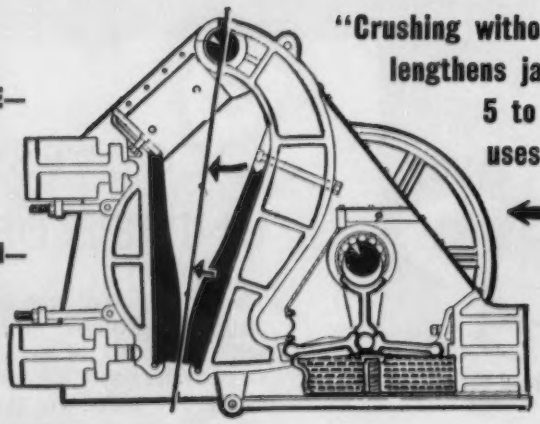
(and crushes finer)

NO SHAFT OR FRAME BREAKAGE—

a built-in safety device releases flywheel instantly on overload. No shearing or breaking parts. Quickly reset.

CRANKCASE TYPE LUBRICATION—

Kue-Ken is the only crusher whose mechanism operates in a bath of filtered, dust-free oil. Mechanism is protected from wear for life of crusher. Toggles do not wear out. Change oil twice a year.



"Crushing without rubbing" lengthens jaw plate life 5 to 10 times... uses less power

See how the Kue-Ken hinge pin is located on the centerline of the crushing zone. The jaw moves in an almost straight line Rock is instantly gripped and crushed without rubbing.

KUE-KEN CRUSHERS

"LOWEST COST-PER-TON CRUSHING"

Jaw Crushers Gyratory Crushers Overhead Eccentric Crushers Revolving Screens
Classifiers Feeders Rib Cone Ball Mills Concentrating Tables Vibrating Screens

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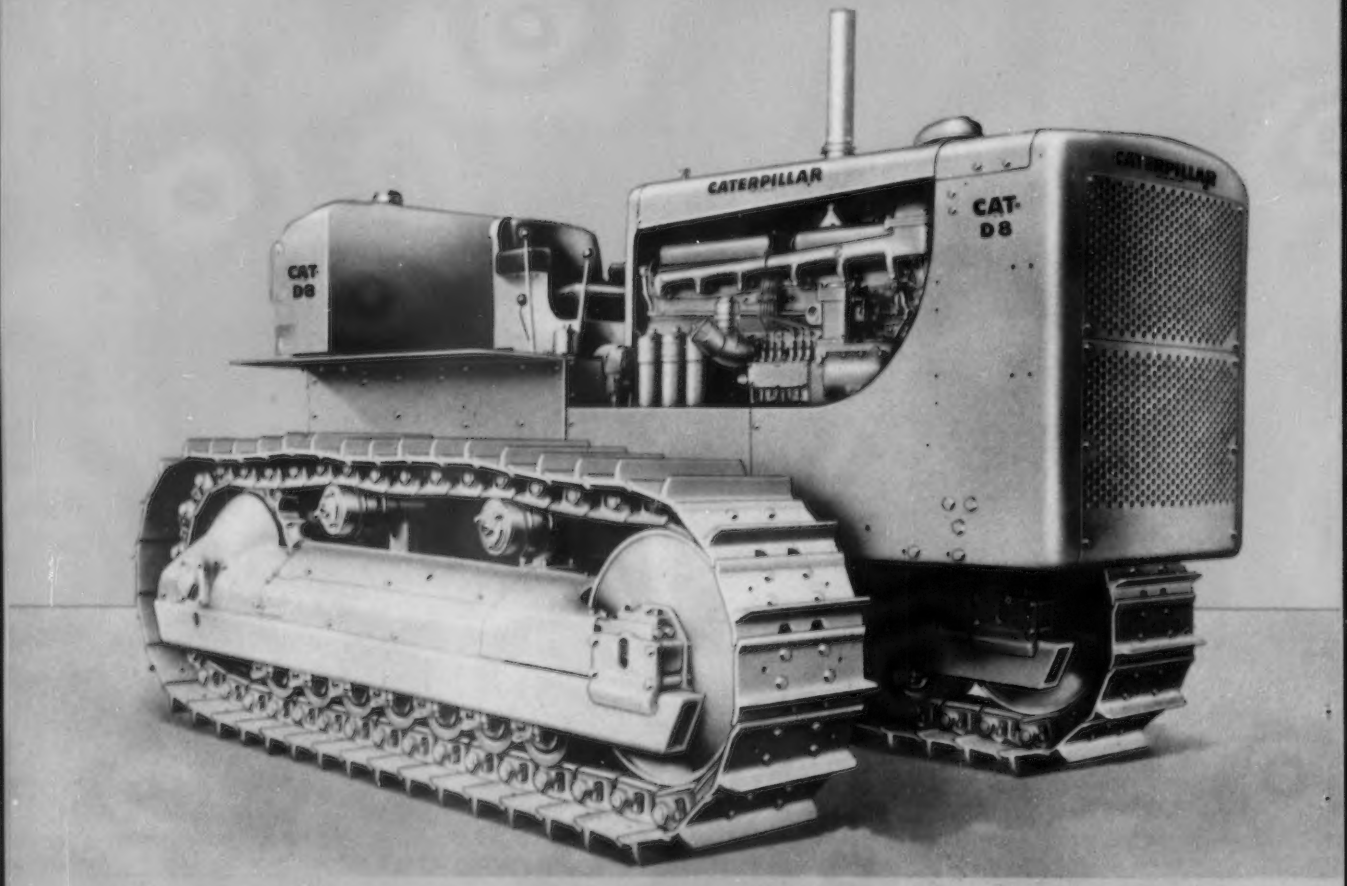
Pennsylvania Crusher Co., Exclusive Licensed Eastern Manufacturer and Distributor, 323 S. Matlack St., West Chester, Penn.
Armstrong Whitworth (Metal Industries) Ltd., Authorized Licensed Manufacturer and Distributor. Close Works, Gateshead-upon-Tyne 8, England

NEW

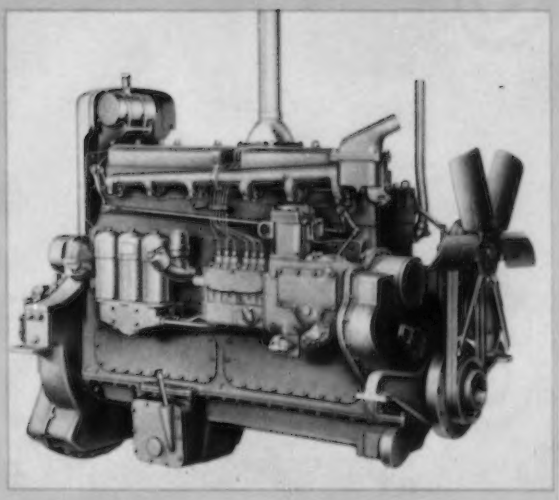
CATERPILLAR ANNOUNCES THE NEW D8

SERIES D and SERIES E

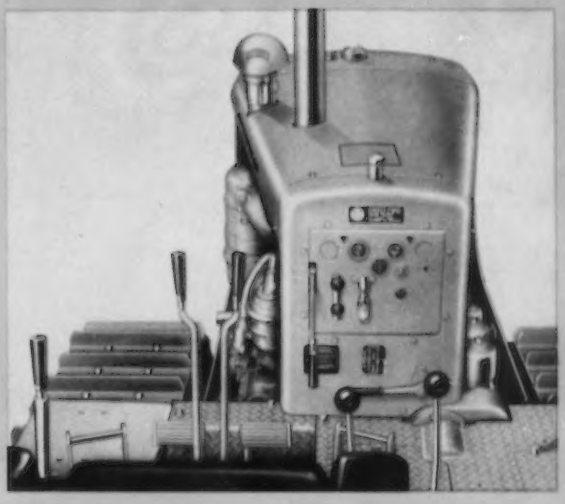


Choice of TORQUE CONVERTER or DIRECT DRIVE

You're looking at a major advance in tractor design—the new Caterpillar D8 Tractor. While it still bears the name of the unit that earned world-wide recognition as "boss of the crawlers," it is basically a *new* machine with 155 HP at the drawbar and your choice of torque converter (Series D) or direct drive (Series E). From its new 7-roller track frame to its new 191-HP, 1200-r.p.m. engine, it is built to deliver an even higher standard of money-making production on *any* track-type tractor application in *any* field. Along with its advance-design features, it retains such outstanding Caterpillar exclusives as the oil clutch and certain other job-proved developments. As a result, you can figure on it for *more* work at *lower* cost with *less* down time on *any* job. For complete information about the new, heavy-duty D8 Series D and Series E, see your nearby Caterpillar Dealer.

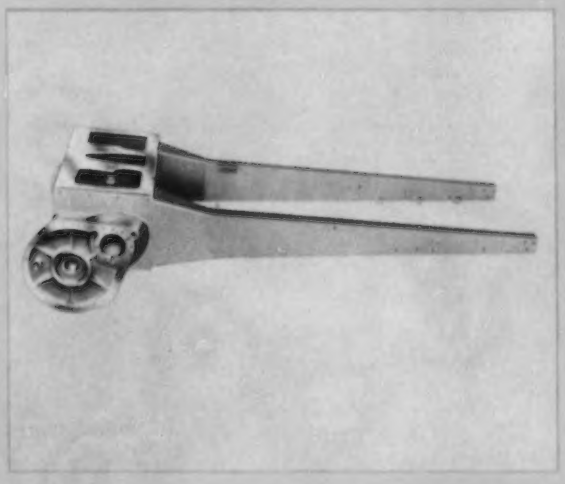


NEW **ENGINE,** with new fuel injection system incorporating capsule-type injection valves. Flanged center main bearing to take crankshaft thrust. "Hi-Electro" hardened timing gear integral with crankshaft.



NEW **EASY-WORKING CONTROLS** handy to comfortable, one-man seat. The new streamlined hood affords greater visibility. The new easy-to-see instrument panel is attached direct to engine.

NEW **"LIVE SHAFT" DRIVE,** independent of flywheel clutch. This important new feature provides constant power for rear-mounted cable controls or other equipment.



NEW **WELDED ONE-PIECE STEERING CLUTCH CASE**—main frame assembly for a stronger "backbone." Transmission and steering clutches can be removed without disturbing other parts.

NEW **OPTIONAL DRIVE,** torque converter or direct drive, whichever is best for your job. *Torque converter:* torque multiplication of 5 to 1 gives smooth operation in each speed range. 3 forward and 3 reverse: low 0 to 3.6 m.p.h.; intermediate 0 to 5.3 m.p.h.; high 0 to 7.4 m.p.h. *Direct drive:* 5 speeds forward and 3 reverse.

NEW **7-ROLLER TRACK FRAME** for greater stability, flotation and better ride.

NEW **"WATER-QUENCHED" TRACK SHOES** for longer life than ever before.

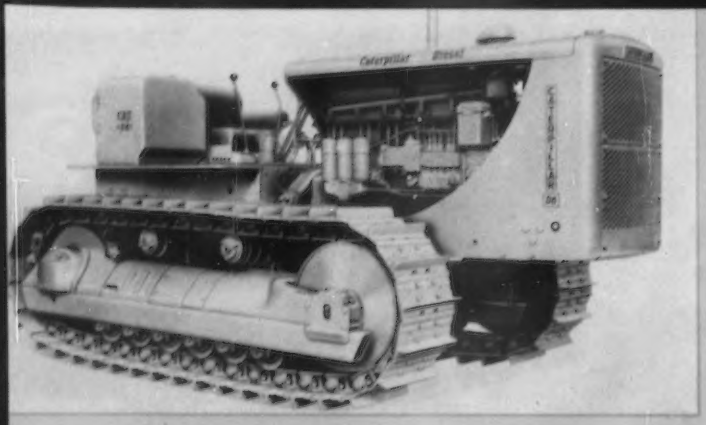
NEW **HYDRAULIC BOOSTER STEERING,** pump drive direct from engine, independent of flywheel clutch, for maximum steering ease.

NEW **STARTING ENGINE** with more power for faster, surer starts in any weather.

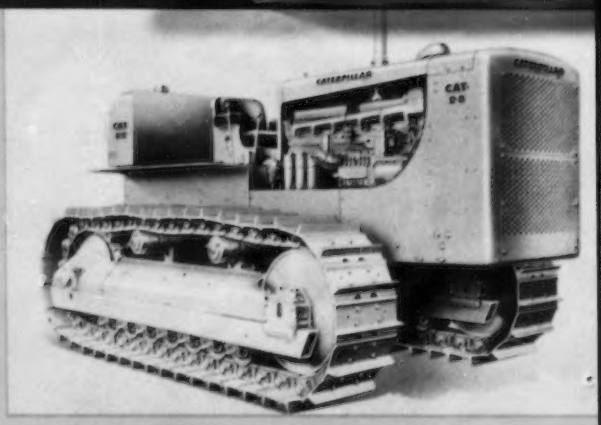
NEW **"IN-SEAT" STARTING** for greater convenience.

NEW **118-GALLON FUEL TANK,** enough for normal 12-hour operation.

NEW **ATTACHMENTS** include cable controls—the new rear-mounted double drum No. 29 with constant power drive direct from engine, and the new front single drum No. 30. New, larger No. 8A and No. 85 Bulldozers, both cable and hydraulic controlled, are also available. The new No. 8U "U"-blade 'dozer has extra strength. Cable-controlled 'dozers use a 6-part line for greater lifting power. All equipment used on the D8 can be used on the new D8 Series D and Series E.



The D8



The NEW D8 Series D and Series E

CHECK THE DIFFERENCE ADVANCE DESIGN MAKES BETWEEN THE D8 AND THE NEW D8 Series D and Series E

	D8	D8 Series D with torque converter	D8 Series E with direct drive
Operating Weight	38,155 lb.	41,265 lb.	40,430 lb.
Ground Clearance	10⅛ in.	13 in.	13 in.
No. Track Rollers	6	7	7
No. Track Shoes	39	42	42
Length of Track on Ground	99¼ in.	111¾ in.	111¾ in.
Area Ground Contact 22-in. Shoe	4389 sq. in.	4917 sq. in.	4917 sq. in.
Fuel Tank Capacity	98 gal.	118 gal.	118 gal.
Drawbar	Swinging	Fixed	Fixed
Drawbar Pin Size	1¾ in. dia.	2¼ in. dia.	2¼ in. dia.
Steering Clutch	Over center spring booster	Hydraulic booster	Hydraulic booster
Steering Clutch Case	Cast iron. Integral with transmission case.	Steel fabricated. Separate from transmission case.	Steel fabricated. Separate from transmission case.
Transmission Case	Cast iron. Integral with steering clutch case.	Cast iron barrel. Separate from steering clutch case.	Cast iron barrel. Separate from steering clutch case.
Main Frame	Box section bolted to cast case.	Box section welded to steel case.	Box section welded to steel case.

Production-wise and profit-wise, you have a new yardstick of performance in the CAT* D8 Series D and Series E. Your Caterpillar Dealer, source of prompt service, will be glad to show you how this rugged new yellow machine can pay off for you!

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR*

*Both Cat and Caterpillar are registered trademarks—®

MAIL TODAY!

CATERPILLAR TRACTOR CO., Peoria, Illinois, U. S. A.

Please send me additional information on the D8 Series D and Series E.

Name_____

Company_____

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City_____ Zone____ State_____

The new D8 Tractor —another example of CATERPILLAR LEADERSHIP in action

PRINTED IN U. S. A.

For Your Files

This informative manufacturers' literature is free unless otherwise specified. To obtain bulletins circle their numbers on card below and mail.

CEMENT HANDLING. A 20-page, two-color booklet on cement handling and storage equipment has been issued by Fanning-Schuett Engineering Co., Philadelphia, Pa. Covers equipment for central mix and transit mix plants; cylindrical, conical and rectangular bins; portable storage bins; collecting cars; rotary values, scales; batchers and beam equipment. **(82)**

STEEL TUBING. Trent Tube Co., East Troy, Wis., (Crucible Steel Co.) has published a 48-page book, "Trentweld Stainless and High Alloy Tubing." Guide to applications is included, with tables on corrosion, etc., welding, bending and installation techniques. **(83)**

LIFT CRANE. Koehring Co., Milwaukee, Wis., has published an 8-page catalog to illustrate and describe construction features, work capacity and wide application of this 20-ton lift capacity excavator. Model 405 is completely modern in design with only two major shafts in the upper machinery and quick acting automatic traction brakes. **(84)**

BATTERY LOCOMOTIVES. Efficient, trouble-free, low-cost haulage is what Goodman Mfg. Co., Chicago, Ill., is tempting you with on the cover of its Bulletin No. M-549, a clinical examination of the whole family of Mancha storage battery locomotives. **(85)**

CHURN DRILL TOOLS. Besides containing comprehensive data on the full line of churn drill tools made by Spang and Co., Butler, Pa., this bulletin has some concise notes on upkeep of equipment. There's a section on dressing and hardening bits and a brief but excellent note on the causes and cures of such headaches as battering of bits, water-course splitting, cracking and chipping. There are also some useful tables and an illustrated discussion of the drill ream method of drilling large holes. **(86)**

"MOTIVATION RESEARCH". A powerful tool for all industry, including mining, which finds out the 'why' of the way people act, is described in a tract by Dunlap & Associates Inc., Stamford, Conn. It accompanies their pamphlet on a suggested conference course entitled "Psychological Factors in Man Management". The brief, meaty course is aimed at business and industrial executives. **(87)**

MAGNETIC SEPARATORS. Covered in Bulletin B 1500, just released by Dings Magnetic Separator Co., Milwaukee, Wis. Applications of their full line of wet separators and concentrators are given. **(88)**

TANKS. Wood, steel, and rubber covered —their dimensions, specifications, illustrations and price are among the facts presented in the Denver Equipment Co., Denver, Colo., Bulletin T2-B5. **(89)**

LUBRICATION. 'How to' on engines and compressors with the dry powder, "Molykote" is briefly stated in Field Report #140 from the Alpha Corp., Stamford, Conn. **(90)**

INDUSTRIAL SAFETY EQUIPMENT, divided into four categories—eye, head, respiratory and welding protection—is given in a General Catalog by Willson Products Inc., Reading, Pa. Designed as a workable, everyday safety manual and reference. **(91)**

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R 7	R104	R209	R217	R402	R505	R512	R600	R608
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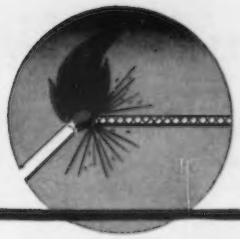

LIGHT IT—*and walk away!*

Ignitacord will ignite every fuse in the round

Less hazard and *greater efficiency* are two reasons why the new type IGNITACORD* is gaining favor for rotation firing.

1. The Blaster lights the Ignitacord at one point—and leaves the face. The Ignitacord can be ignited with safety fuse to obtain a longer delay if desired.

2. All fuses in the round are cut to uniform length. There is no need for trimming, since accurate time delay and proper rotation is governed by the length of Ignitacord used between holes.

IGNITACORD burns progressively at a uniform speed along its length with an external flame at the zone of burning. The flame is short and hot — acts like the flame of a Hot Wire Lighter.

Two types are available. Type A burns at approximately 8 to 10 seconds per foot. Type B burns at approximately 16 to 20 seconds per foot. Each type is packed on 100-foot spools with identifying label. Both types are color-marked at one-foot intervals, making it easy for the Blaster to connect the fuses at correct intervals.

IGNITACORD CONNECTORS provide the most efficient and convenient method of attaching Ignitacord to Safety Fuse. The Connector is a metal shell containing an ignition charge. The shell is slipped over the freshly cut end of the fuse and crimped. A slot near the opposite end receives the Ignitacord, which is held firmly in place when the top is pressed down against it. Ignitacord Connectors are supplied in packages of 100.

*Sold on the West Coast under the name of SPITTERCORD by the Coast Manufacturing and Supply Co., Livermore, California.

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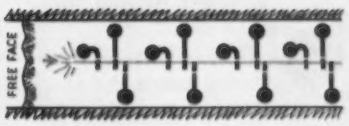
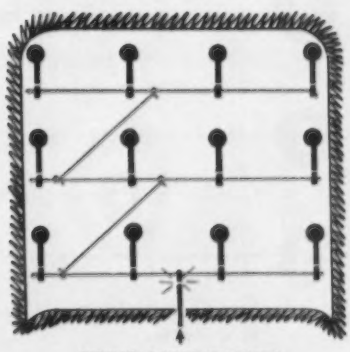
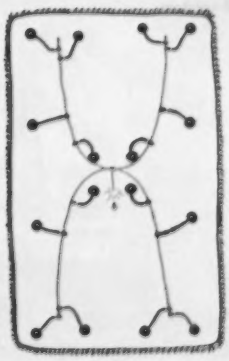




FIRING STOPE ROUNDS

Fig. 1 shows a stope drilled with three rows of uppers, the fuse from each hole being connected to a single line of Ignitacord. Note that the center holes will fire before the two corresponding rib holes.

In *Fig. 2* the fuses extending from the horizontal breast holes are connected to four lines of Ignitacord at regularly spaced intervals. Jumper lines connect the horizontal lines, and the Igniter cord is activated by a length of Safety Fuse at Point A.



FIRING DEVELOPMENT ROUNDS

Fig. 3 illustrates an Ignitacord hook-up arranged to fire the cut holes in one group, and the remaining holes in the proper order of rotation. Ignitacord lines should always be kept separated enough to avoid cross ignition.

The facts speak for themselves . . .

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The entire shell of the bucket on this 50-cu. yd. power shovel is fabricated from ¾" and 6½" "T-1" Steel Plate. Liner plates are made of ½" "T-1" Steel. "T-1" Steel Plate only 6½" thick has replaced large castings a foot thick in the lip of the bucket. Lighter weight construction with "T-1" Steel made it possible to increase the cubic capacity of the bucket by ten yards.

How USS "T-1" STEEL in big machines cuts weight, cuts cost, increases service life

Hanna Coal Company just can't afford to have this giant 50-cu. yd. shovel break down. This machine can move 2,280,000 tons of material a month, and it must operate continuously—24 hours a day, 7 days a week—to pay off.

Strong, weldable "T-1" Steel has improved the performance of this incredibly rugged machine, and it also has cut cost and weight. It enables the designers to use *fabricated* parts in place of larger, heavier, more expensive castings. And these lower-cost fabricated parts actually *last longer* than castings. As a result, Hanna Coal Company has standardized on "T-1" Steel for the vital parts of much of its heaviest-duty equipment.

Write for complete information on new USS "T-1" Steel. It has application in pressure vessels, rotating machinery, structural steel towers, steel mill equipment, big trucks, mine cars, and elsewhere.

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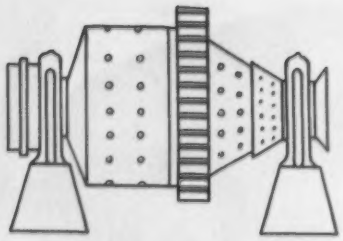
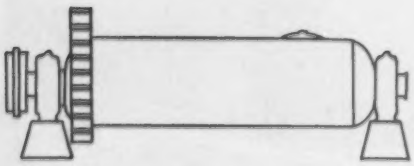


CONICAL MILLS



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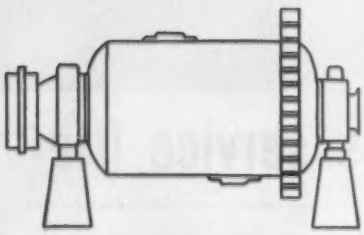

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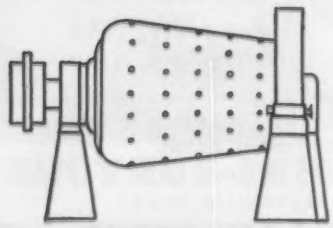

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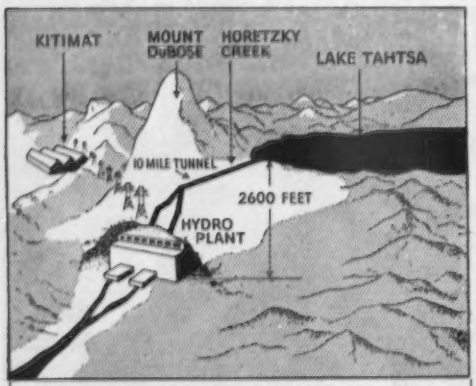
DRIVING A 10-MILE TUNNEL FOR $500-MILLION ALCAN PROJECT

Atlas Copco Light Rock Drills fitted with 'Sandvik Coromant' tungsten-carbide-tipped Drill Steels cut Tahtsa Lake-Horetzky Creek section... shows performance advantage over heavy equipment.



This chart shows the extent of the $500-million Alcan project—probably the largest engineering feat ever undertaken by a single industrial concern.

They can do anything nowadays. Change rivers flowing east, west. Drive tunnels through the heart of a mountain. Scoop out a mountain to build an underground power house. Erect transmission lines over wild passes . . . This sort of enterprising thing took place on the recently-completed hydro-electric project in British Columbia, Western Canada, for the Aluminium Company of Canada (Alcan), and will provide cheap, abundant power for their new aluminium smelting plant at Kitimat, 50 miles to the north of the power house.

Atlas Copco drills—one-man machines—drilling with Sandvik Coromant Drill Steels on the West Tahtsa tunnel face.

LIGHT ROCK DRILLS VERSUS HEAVY DRIFTERS

The now harnessed waters of the Nechako River flow into the Tahtsa Lake reservoir, then down the 25-foot horseshoe-shaped tunnel, 10 miles long, to the underground power house at Kemano. Tunnelling from the upstream end—Tahtsa Lake to Horetzky Creek—was undertaken by Atlas Copco lightweight rock drills and Coromant tungsten-carbide-tipped drill steels. (This equipment was supplied by Canadian Copco Limited.) Heavy drifters of a different make and fitted with detachable bits tunnelled from the downstream and at Kemano. How did the two types of equipment compare?

TOUGH GOING, BUT TIME LIMIT KEPT

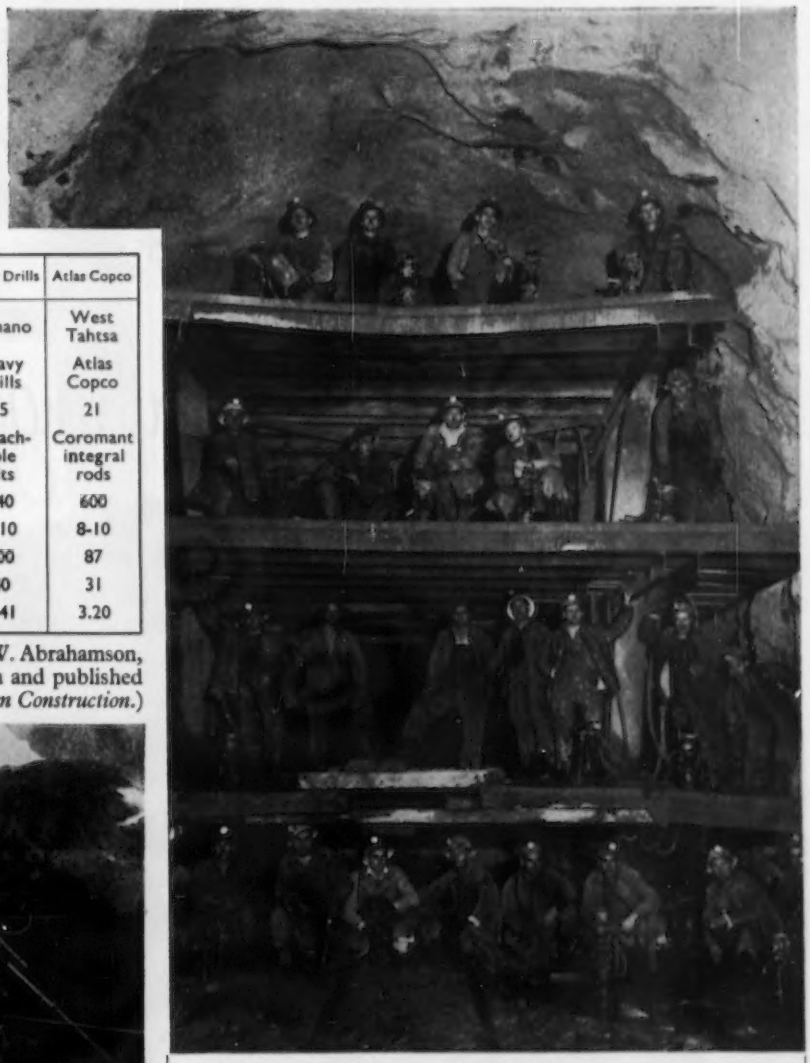
Rock encountered from the upstream end consisted of greenstone and metamorphic complex—probably the worst rock formation encountered on the tunnelling projects. In spite of the enormous difficulties this created, Atlas Copco machines did an outstanding job, and the rigid time limit—the end of 1953—was kept. Atlas Copco light rock drills are one-man machines, and because of this it was possible to employ a greater number of drills simultaneously at the face. As the penetration rate per rock drill was about the same for the two types of drills, *the drilling time per round was considerably shortened using Atlas Copco drills. At the same time, their drilling crews were only 60 to 70% of the crews needed for the*

heavier drills. On the whole, the light equipment was far more economical, with overall lower capital outlay, labour and maintenance costs. For further comparison, see the table below, which gives some typical data for drilling with the two types of equipment.

	Heavy Drills	Atlas Copco
Heading	Kemano	West Tahtsa
Make	Heavy Drills	Atlas Copco
Number of rock drills	15	21
Bits. Steels	Detachable bits	Coromant integral rods
Footage per bit	240	600
Number of regrinds	8-10	8-10
Drilling time in minutes	100	87
Typical total shift crew	40	31
Pounds of powder per cu. yard	5.41	3.20

(The information was compiled by C.W. Abrahamson, Assistant Resident Engineer for Alcan and published in the December 1953 issue of *Western Construction*.)

Atlas Copco light rock drills were also used in clearing the way for the erection of 50 miles of transmission lines from Kemano power house to the smelting plant at Kitimat.



Every man to a machine! This picture taken at the West Tahtsa tunnel face clearly shows how a large number of Atlas Copco light rock drills can be handled by a small crew.

Atlas Copco Compressed Air Equipment is manufactured or sold and serviced in 48 countries throughout the world by *The Atlas Copco Group*, which embraces companies trading under various names such as Atlas, Atlas Diesel, Atlas Polar, Atlas Copco, Copco, Delfos and Sampa.

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U.S.A., Copco Pacific Ltd., 930 Brittan Avenue, San Carlos, California; Copco Eastern Ltd., P.O. Box 2568, Paterson 2, N.J.; CANADA, Canadian Copco Ltd., Montreal, A.M.F., Quebec; MEXICO, Copco Mexicana, S.A., Apartado Postal 56, Torreon, Coahuila; PERU, Compania Atlas del Peru, S.A., Apartado 2982, Lima.
UNITED KINGDOM, The Atlas Diesel Co. Ltd., Wembley, Middx.; FRANCE, Atlas Polar S.A., 29, Rue Marbeuf, Paris 8e; HOLLAND, N.V. Holland-Atlas, P.O. Box 6056, Rotterdam; ITALY, S.A.M.P.A., Viale Marche 15, Milan. AUSTRALIA, Australian Atlas Company Pty., Limited, P.O. Box 54, Auburn, N.S.W.; SOUTH AFRICA, Delfos (Pty) Ltd., P.O. Box 504, Benoni, Transvaal.

Readers in countries outside those listed here and who do not know the name of their local Atlas Copco company or agent, please write, in the first instance, to AB Atlas Diesel, Stockholm 1, Sweden.

Please forward details of ***Atlas Copco rock drills and Sandvik Coromant drill steels.***

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*I am also interested in other Atlas Copco equipment (please state which below).

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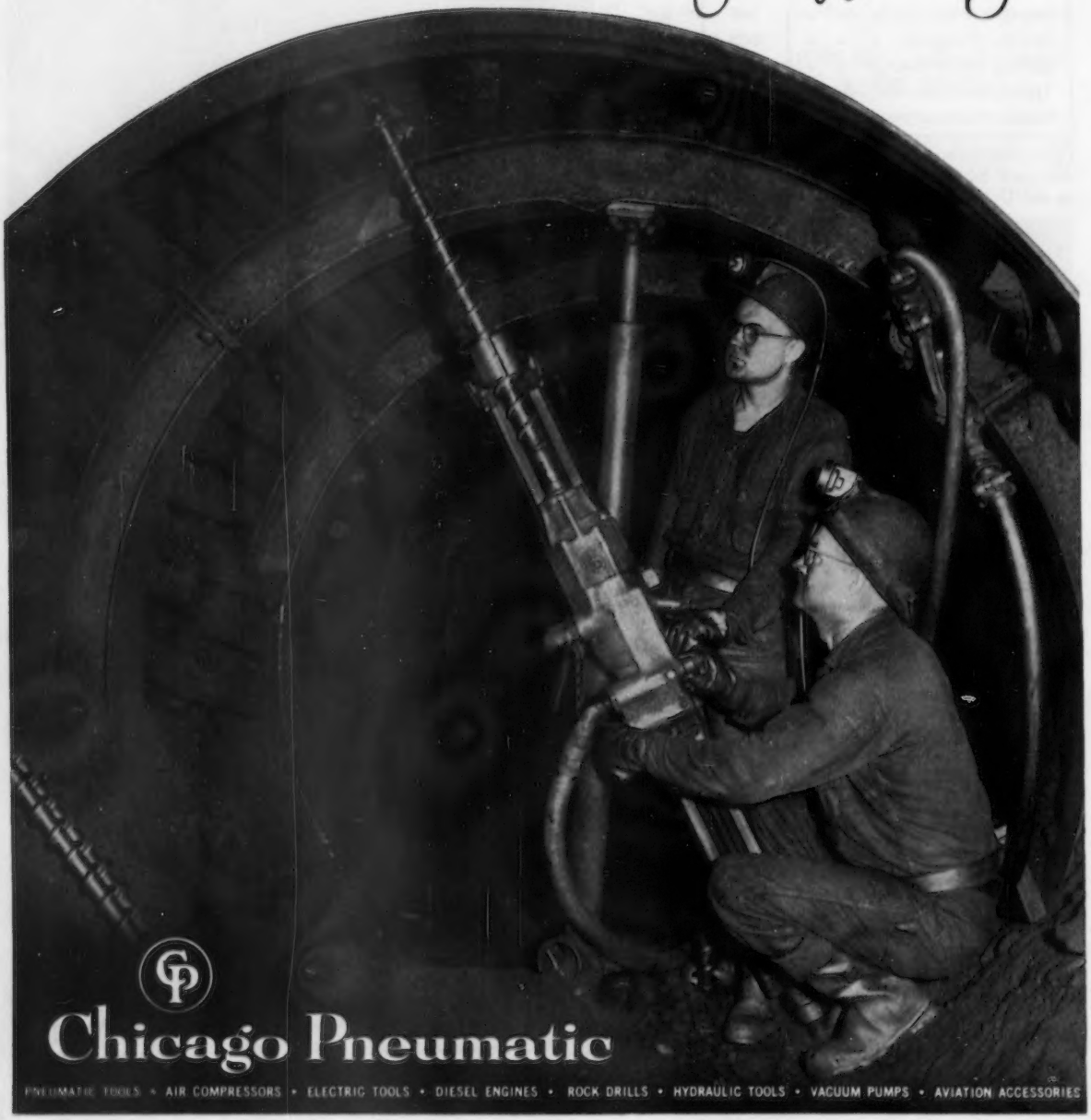

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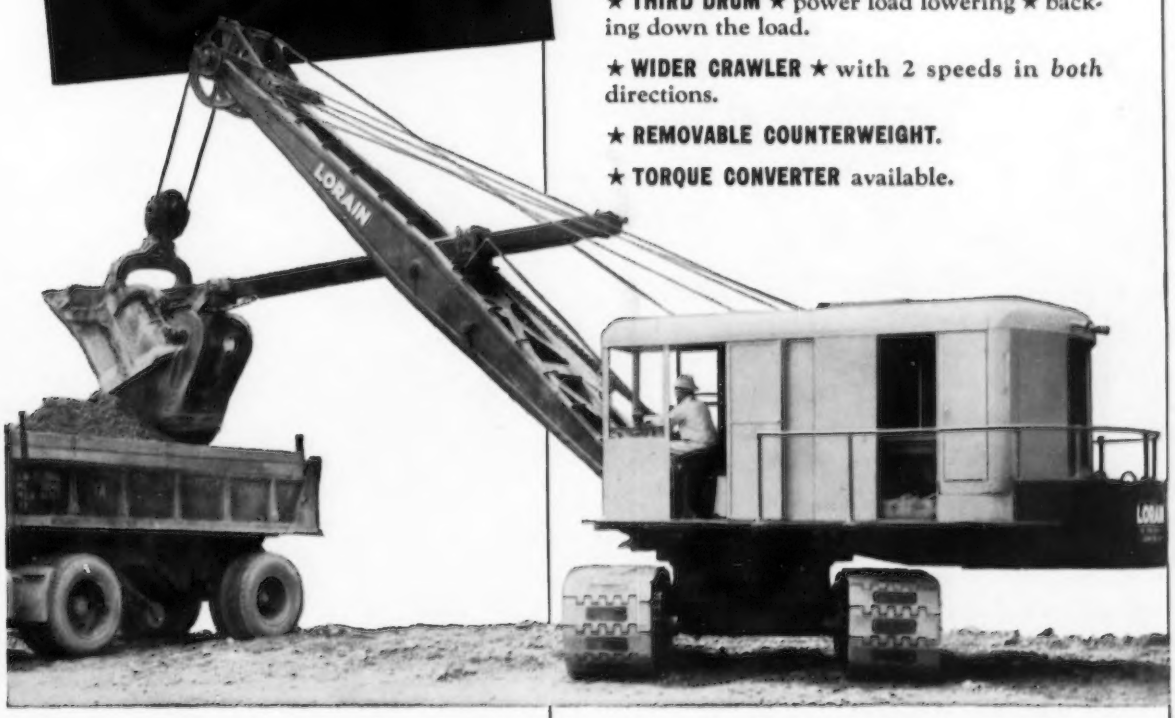

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AEROFLOC® REAGENTS. Latest addition to our family, these flocculating agents accelerate thickening rates, improve filtration and conserve values previously lost to overflow. Several AEROFLOC Reagents are available to suit various conditions.

OTHER REAGENTS. We also supply such widely-used chemicals as AERO® Brand Cyanide, sodium cyanide, soda ash, copper sulfate, sodium silicate, alkali polyphosphates, zinc sulfate, oleic acid and others. We can simplify your inventory by delivering exactly what you need in the quantity you require. Smaller mills benefit by lower freight costs on combination shipments, too.

Whatever your flotation problem Cyanamid Field Engineers can help you get lowest cost-plus-tails with the right combination of Cyanamid Reagents.

COPPER-MOLY	Copper concentrates produced from chalcocite with AEROFLOAT® Promoter average 22% from a feed averaging under 1% Cu. Copper concentrates contain 0.2 to 0.3 MoS_2, from which an 85-90% MoS_2 final product is made by this unique procedure: Depress Cu with Cyanamid sodium ferrocyanide and sulfuric acid in a series of Mo flotation steps to produce a 50-70% MoS_2 product. Regrind. Refloat moly in presence of sodium cyanide to make 85-90% MoS_2 concentrate. (U.S. Patent 2,664,199).
PHOSPHATE ROCK	At Cyanamid's Florida operations, phosphate rock and quartz are floated with crude tall oil (AERO* Promoter 708). Rougher concentrates are washed with sulfuric acid to remove adhering fatty acid. Quartz is then floated off with AEROMINE® 2026 Promoter and kerosene. Final product runs only three to four percent insol and well over 70% bone phosphate of lime. AEROMINE® 2026 Promoter is a recent product of extensive Cyanamid research.
LOW-IRON GLASS SAND	Froth flotation now converts dune sand into valuable, custom-built products. Raw sands, comprising equal parts of quartz and high-alumina minerals, average 0.12 to 0.15% Fe_2O_3 and 11.5% Al_2O_3. Scrubbed in attrition machines, these sands are then deslimed, conditioned and iron-bearing minerals floated, leaving behind 95% of the feed in a finished product that assays 0.06% Fe_2O_3 and 10.7% Al_2O_3. Flotation reagents used include sulfuric acid to adjust pH during conditioning to 2.5, pine oil, fuel oil, and Cyanamid AERO* Promoters 801 and 825. Subsequent flotation in another section produces a high-grade feldspar concentrate and a practically-pure quartz tailing. Tailor-made blended quartz-feldspar products are also produced.
ILMENITE	Apatite-ilmenite ore in an amphibole-pyroxene-silicate and clay gangue is crushed, ground and run through Humphreys spirals. Middlings and concentrates are completely deslimed, conditioned at 70% solids with AERO* Promoter 710 and a bulk apatite-ilmenite concentrate is floated off. Bulk concentrate is dewatered and conditioned for apatite flotation at 70% solids and 90° F with caustic starch and AERO* Promoter 708. Separation of apatite from ilmenite is 99.97% complete.

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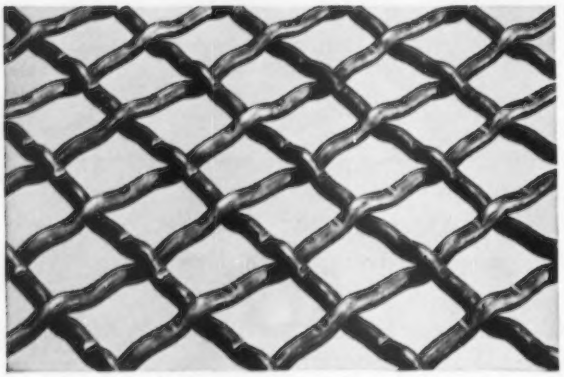

Screen Cloth. Hewitt-Robins screen cloth is specially engineered to accurately size large tonnages and cut screening costs . . . utilizing a full range of metallic wire to meet individual job requirements . . . available in standard production size openings from 3/16" and coarser; wire sizes from .105" up to and including 1" diameter.

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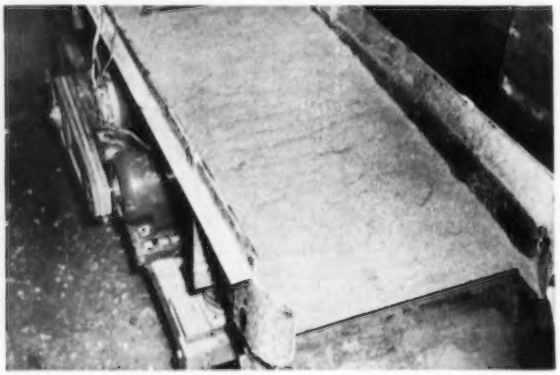
Vibrating Screens. Hewitt-Robins manufactures four types of economical vibrating screens . . . Gyrex® positive stroke 4-bearing screens; Eliptex® horizontal operating flat screens; Vibrex® full-floating, unbalanced pulley-type 2-bearing screens and the Eliptex Dewaterizer having specially designed Eliptex screen with micron-size opening stainless steel flat rod deck.



Vibrating Feeders and Conveyors. Fully mechanical, high capacity—low power consumption vibrating feeders easily maintained by your own personnel. Continuously balanced vibrating conveyors now available in longer units with higher capacities at lower horsepower. Handle a wide range of materials—wet or dry, lump or pulverized, packaged or loose, hot or cold, abrasive or corrosive.

Hewitt-Robins

Conveyor Belting—Conveyor Machinery—Industrial Hose—Vibrating Screens—Vibrating Conveyors—Design, Manufacture, Engineering and Erection of Complete Bulk Materials Handling Systems.

HEWITT-ROBINS INCORPORATED • STAMFORD, CONNECTICUT

SWIVEL HOOK

SAFETY HOOK

EYE BOLT

CLEVIS

New Bulletin 76-J gives application of Joy Sheave Blocks

JOY SHEAVE BLOCKS ARE BUILT TO YOUR SPECIFICATIONS!

HERE'S HOW THEY'LL SIMPLIFY YOUR SCRAPING JOB

Joy Tail Rope Sheave Blocks were developed *in the mines,* by mining men—specifically for the rugged job of scraper loading.

Every design detail has been thrashed out, in service, to give real "bug-free" operation. For example:

- Extra wide sheave wheels reduce rope wear.
- Quick-opening snatch blocks allow fast, easy rope changes.
- Large throat openings and flared side plates will actually pass knots tied in *wire rope.*
- Sealed-for-life bearings are watertight, dust-tight, and require *no lubrication.*
- Tough alloy steel is used for side covers, wheels, hooks, eyelets and clevises.
- All steel construction—can be picked up by magnets if lost in a load.

A Joy Sheave Block is a stout, durable piece of equipment that requires practically *no attention.* It's just the ticket for hard-to-reach-to-service jobs. ● Get the full story today—write for Bulletin 76-D. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Consult a Joy Engineer

QUICK-OPENING SNATCH BLOCK CONSTRUCTION

Opened block showing milled slot. Pin removed.

Block closed, pin in place, locking key in "Open" position.

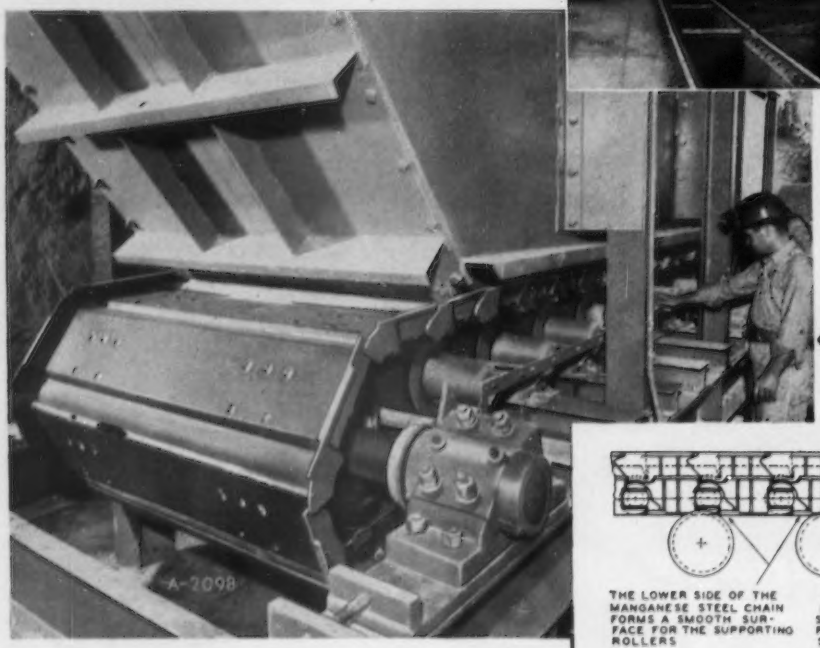
Block closed, pin in place, key in "locked" position.

WAD M4666B

JOY

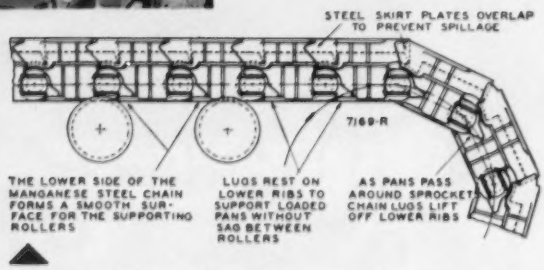
WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING EQUIPMENT

S-A "AMSCO" MANGANESE FEEDERS



"AMSCO" Feeders withstand the punishing impact and abrasion of ore loads—often falling many feet—through multi-million ton service. One unit logged over 26-million tons in a seven year period, another has handled 65-million tons in 23 years . . . typical examples of outstanding service in both long life and tonnage.

This "AMSCO" secondary feeder discharges to belt conveyor. An S-A Tel-level control automatically stops the feeder if there is a choke-up.


STEEL SKIRT PLATES OVERLAP TO PREVENT SPILLAGE
7169-R
THE LOWER SIDE OF THE MANGANESE STEEL CHAIN FORMS A SMOOTH SURFACE FOR THE SUPPORTING ROLLERS
LUGS REST ON LOWER RIBS TO SUPPORT LOADED PANS WITHOUT SAG BETWEEN ROLLERS
AS PANS PASS AROUND SPROCKET CHAIN LUGS LIFT OFF LOWER RIBS

Elevation of S-A "AMSCO" pans and chain showing knee-action lugs at joints. Lugs permit chain to bend freely around sprockets but prevent sagging between track-rollers, even under load. Bottom of chain forms a smooth surface for the track-rollers.

No Matter How Brutal the Beating, They Come Back for More...MUCH LONGER

Because all wearing parts are made of MANGANESE, the toughest steel known to man

Thousands of tons of ore and rock crash down every day . . . and these smashing, loading impacts continue year after year . . . yet S-A "AMSCO" Feeders unfailingly handle high tonnages from car dumps, primary crushers and loading pockets—feeding to or from scalping screens — meeting every application where feeders must absorb heaviest abrasive punishment . . . with practically no maintenance.

Nothing but Manganese steel will withstand these repeated, punishing impacts, this constant abrasive action . . . that's why in S-A "AMSCO" Feeders, pans, chains, pins, bushings, track roller, sprocket — in fact *all components subject to wear* — are made of manganese steel . . . and actually become tougher and more abrasion-resistant with repeated shocks.

S-A "AMSCO" Feeders are individually engineered to provide lowest cost-per-ton handling for heaviest-duty applications. Tremendous in size and capacity, they have a life expectancy rated in millions of tons — as proved by their record in mines since 1924.

An S-A engineer will give you complete information — or wire for our Bulletin No. 255.

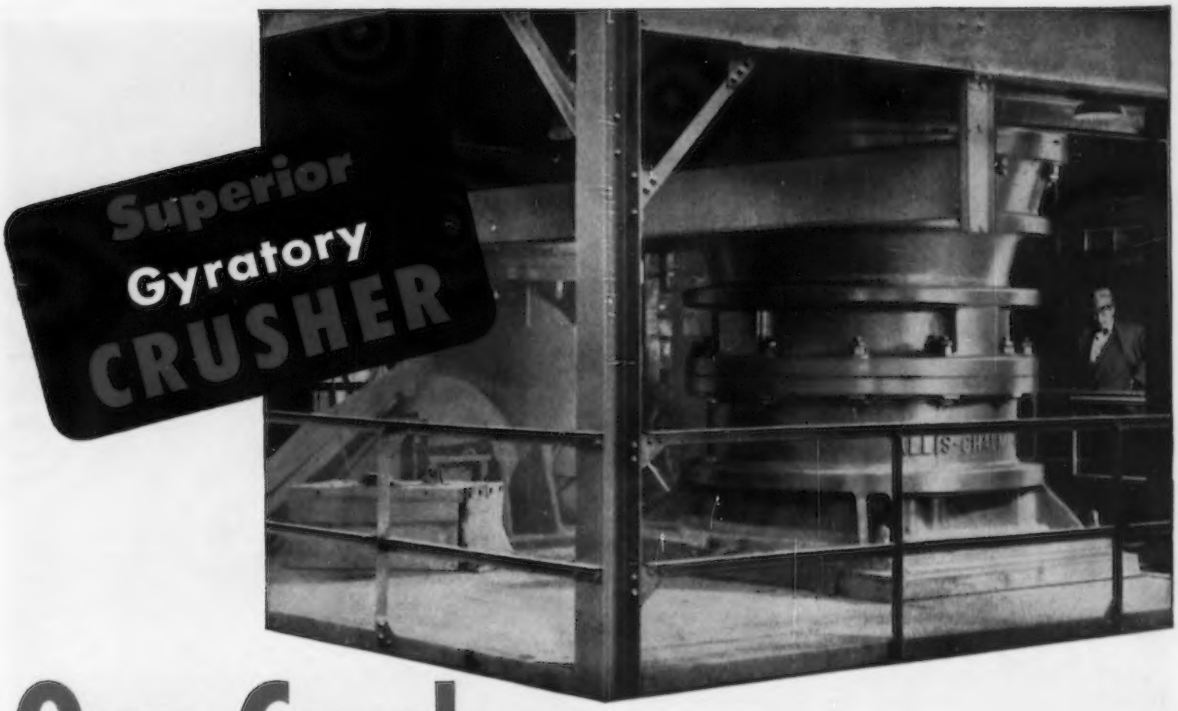
STEPHENS-ADAMSON MFG. CO.

4 Ridgeway Avenue, Aurora, Ill. • Los Angeles, Calif. • Belleville, Ont.

Engineering Division
Specialists in the design and manufacture of all types of bulk materials conveying systems.

Standard Products Division
A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.

Sealmaster Division
A complete line of industrial ball bearing units available in both standard and special housings.



One Crusher... Does Work of Two!

HOMESTAKE MINING Company installed a modern 30-55 *Superior* gyratory crusher to replace two old *Gates* gyratories. Despite the fact that the new crusher has a 30-inch feed opening, instead of a 17-inch opening as on the old crushers, it fits snugly into half the former space for two. The *Superior* can turn out much more tonnage than both old crushers. And it's built to surpass the 38-year service record of the old crushers.*

This increased capacity and improved performance is a direct result of over 70 years of experience in building crushers, years in which Allis-Chalmers leadership introduced many design advantages in gyratory crushers — the short mainshaft . . . improvements in the shape and size of the crushing chamber, in weight distribution, in dust protection and lubrication. These and other features mean more *profitable* crushing for you, when you specify Allis-Chalmers! A-4195

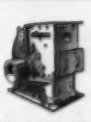
For more facts on *Superior* primary or secondary crushers, call the Allis-Chalmers representative in your area or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 07B7870.

Yes, the old Gates crushers were built by Allis-Chalmers too — back in 1913!

Superior and *Gates* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

Sales Offices in Principal Cities in the U. S. A. Distributors Throughout the World.


Hammermills

Vibrating Screens

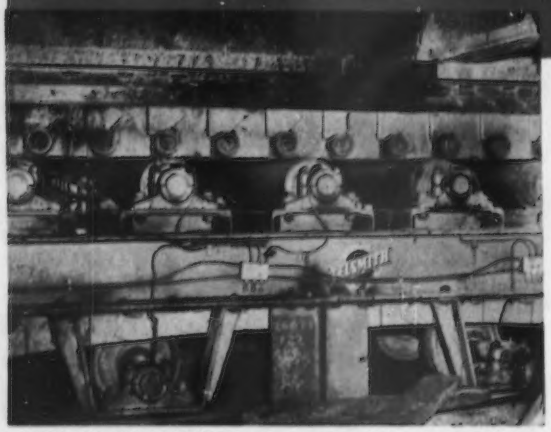
Jaw Crushers

Gyratory Crushers

Grinding Mills

Kilns, Coolers, Dryers

TELSMITH
more economical feeders



CLEVELAND-CLIFFS IRON CO., Negaunee, Michigan has a 48-inch wide x 14-foot long Telsmith Heavy-Duty Apron Feeder with manganese steel flights, feeding a 25 x 36 Telsmith Roller Bearing Jaw Crusher. Capacity is about 3000 tons per day.

● Keep your conveyors, screens and crushers working smoothly and at full capacity. Telsmith Apron or Plate Feeders insure steady, uniformly regulated flow of material to entire plant—boost your output and cut cost of up-keep.

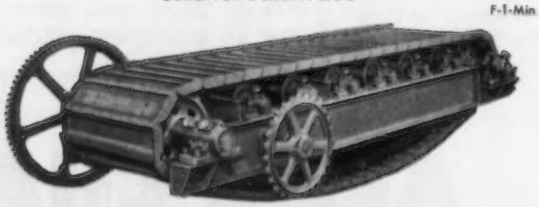
APRON FEEDERS are self-contained units on heavy structural steel frames. **Heavy-Duty Apron Feeders**—with carbon, or manganese steel flights—handle the toughest jobs, such as feeding primary crushers, either jaw or gyratory. **Standard-Duty Apron Feeders**—equally sturdy, but weigh less. Apron Feeders are made in 24-in. to 72-in. widths, with capacities from 25 to 800 tons per hour. Furnished with heavy steel hoppers, at extra cost.

PLATE FEEDERS are simple in design—sturdy in construction. Adjustable stroke regulates capacity. Made in both Standard and Heavy-Duty models; widths 16-in. to 60-in.; capacities 12 to 740 cu. yds. per hr.

Send for Bulletin 266

F-1-Min

TELSMITH Standard PLATE FEEDER with special back gear shaft and drive pulley equipment at extra cost.



TELSMITH Standard-Duty APRON FEEDER—Raised edges of its ⅜-in. steel flights prevent spillage.

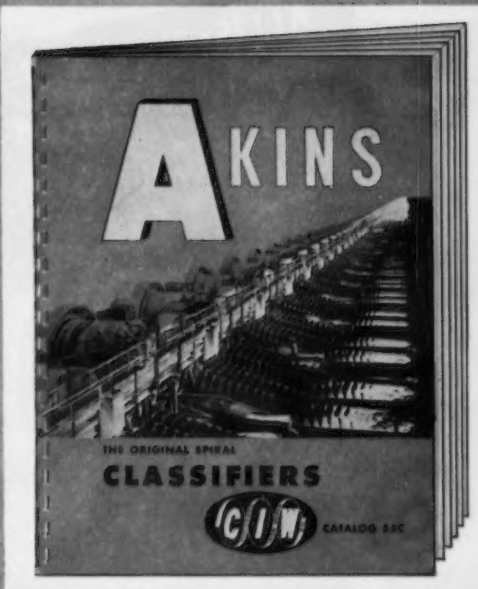
SMITH ENGINEERING WORKS

502 E. CAPITOL DRIVE **MILWAUKEE 1, WISCONSIN**

Representatives in Principal Cities in All Parts of the World • Cable Address: Sengworks, Milwaukee

NEW

AKINS* CLASSIFIER



CATALOG

includes complete data on

- mechanical and metallurgical operation of the Akins
- closed circuit grinding arrangements
- capacity tables
- general dimensions
- applications on metallic and non-metallic ores, industrial and special purpose sands, oyster-shell washing, solar marine salt washing
- spray water box attachment for difficult sand washing problems

SEND FOR YOUR COPY, NOW

COLORADO IRON WORKS CO.
1624 - 17th Street • Denver 2, Colorado

Gentlemen:

I would like to have a copy of your new Akins Classifier Catalog No. 55C.

Name: _____

Company: _____

Title: _____

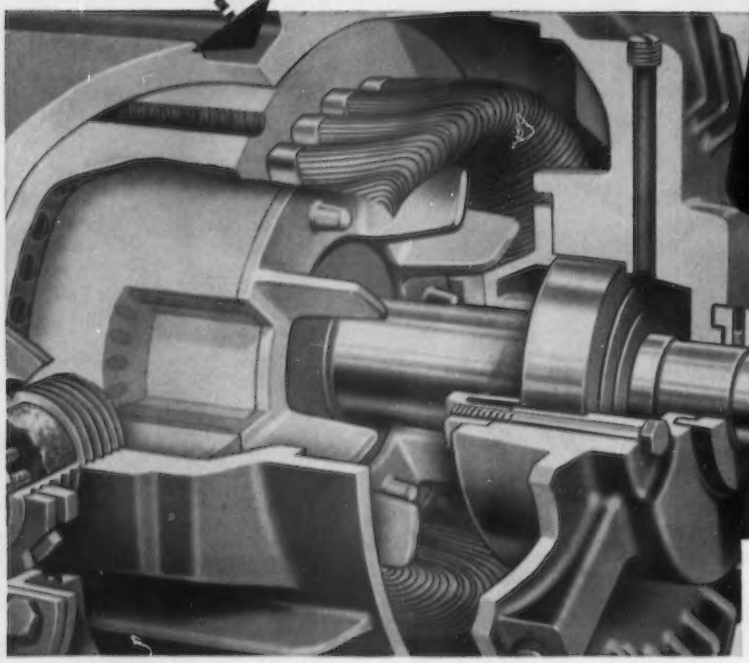
Address: _____

_____

AKINS
the original spiral classifier

*a trademark of the Colorado Iron Works Co.

Get Both bearing features



ALLIS-CHALMERS Totally-Enclosed Fan-Cooled MOTORS

fully enclosed and protected

The bearing cap is held tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

. . . yet easy to grease

You can lubricate the bearings without dismantling the motor. Pipe-tapped holes in the bearing housings at three points provide both means for inserting new grease and a means of flushing out old grease.

Look for the extra bolts on the end housing . . . the sign of greater value. Ask your Allis-Chalmers representative or Authorized Distributor to show you a cutaway section of this maintenance-cutting design. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B7225.

A-4609

ALLIS-CHALMERS

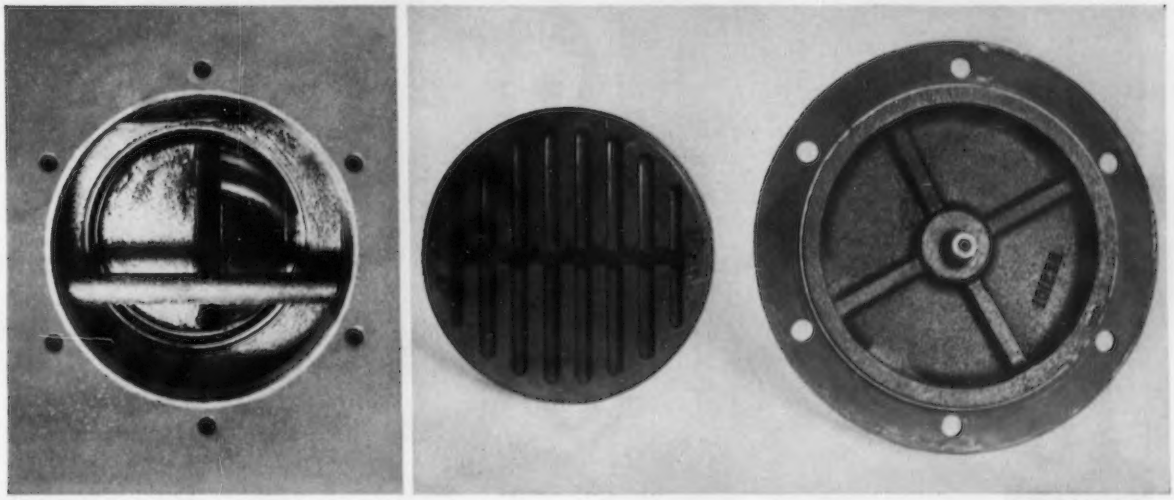
Standard Engineer's Field Report

CASE HISTORY

LUBRICANT *Calol Multi-Service Oils*

LOCATION *Arizona*

Compressor valve parts free of deposits after working 40,680 hours in constant dust



NOTE CLEANLINESS of this valve port, channel valve and cover (left to right) when removed for first time from a two-stage air compressor...after 40,680 hours of work! Lubricated with Calol Multi-Service Oil since installation 11 years ago, the unit supplied air—5000 cubic feet per minute—for a giant Arizona copper mine. Compressor was housed in open shed where dust and grit were always present in the air...yet there was practically no wear or formation of deposits. Since moved to another mine site, the compressor still has all its original parts.

Calol Multi-Service Oils keep wear rates low and carbon deposits to a minimum in any type of reciprocating compressor. Also recommended for pumps, diesel engines and enclosed gears. These oils are available in several different grades to meet all conditions and requirements.

CALOL

TRADEMARK "CALOL" REG. U. S. PAT. OFF.

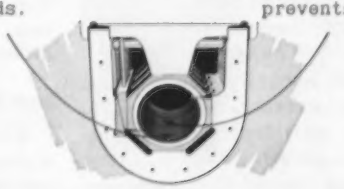
FREE CATALOG: "How to Save Money on Equipment Operation" will be sent on request to Standard Oil Company of California, 225 Bush Street, San Francisco, California.

FOR MORE INFORMATION about this or other petroleum products...or the name of your distributor, write or call any of the companies listed below.

Why CALOL Multi-Service Oils cut deposits & costs

Contain oxidation-resistant compounds.

Detergent keeps contaminants suspended in oil, inhibitor prevents foam.

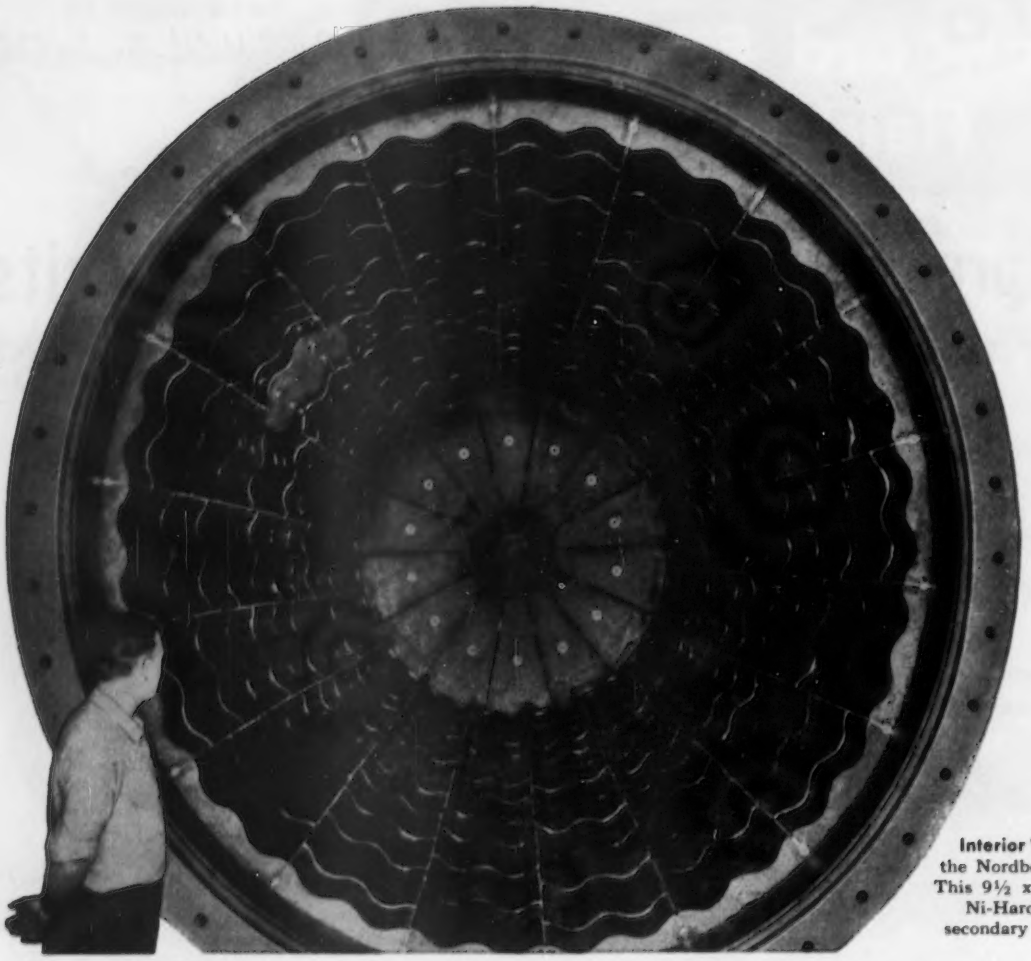


Stay on "hot-spots"... cover surfaces rapidly and uniformly.

STANDARD OIL COMPANY OF CALIFORNIA
225 Bush Street • San Francisco 20, California

THE CALIFORNIA COMPANY
P. O. Box 780 • Denver 1, Colorado

STANDARD OIL COMPANY OF TEXAS
P. O. Box 862 • El Paso, Texas



Interior View of one of the Nordberg ball mills. This 9½ x 34' mill uses Ni-Hard liners in the secondary compartment.

Nordberg applies NI-HARD liners to giant Ball Mills

Nordberg, a leading manufacturer of machinery for processing ores and industrial minerals, is now producing Ni-Hard® liners for use in several of its large ball mills.

Ni-Hard actually doubles and triples the interval between mill relinings by providing maximum resistance to abrasive wear . . . thus maintaining desired liner contours.

A cast product, Ni-Hard liners can be made in practically any design to meet individual grinding requirements. And segments can be fastened by any normal method.

See for yourself, what Ni-Hard can do for you. Replace outmoded liner material with Ni-Hard and obtain *abrasion resistance at lowest ultimate cost.*

Booklet gives complete story

Every plant operator should have a copy of "Engineering Properties and Applications of Ni-Hard." This booklet will give you the facts about Ni-Hard performance, and suggest where Ni-Hard has application in your plant. Write for it now — complimentary of course.

Close-up of Ni-Hard Liners cast by Nordberg Manufacturing Company, Milwaukee, Wisc., for lining the mill, shown above.

INCO TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

ROEPRENE MINING CABLE

Flexible tinned copper conductors insulated with rubber or synthetic rubber compound
Braided copper grounding conductor
Yarn reinforcing braid
Yarn reinforcing braid
Conductors cabled together
ROEBLING 6 AWG P-111
ROEBLING 2 AWG P-111 EM 1955
EM 1955

ROEPRENE Mining Cables are approved by the Pennsylvania Bureau of Mines Approval P-111, and comply with the requirements of the U.S. Bureau of Mines for flame resistance.

YOU WANT

FLEXIBILITY,
EXTREME TOUGHNESS,
RESISTANCE TO WATER,
OIL AND OZONE,
MAXIMUM LIFE...
IN SHORT,

YOU WANT

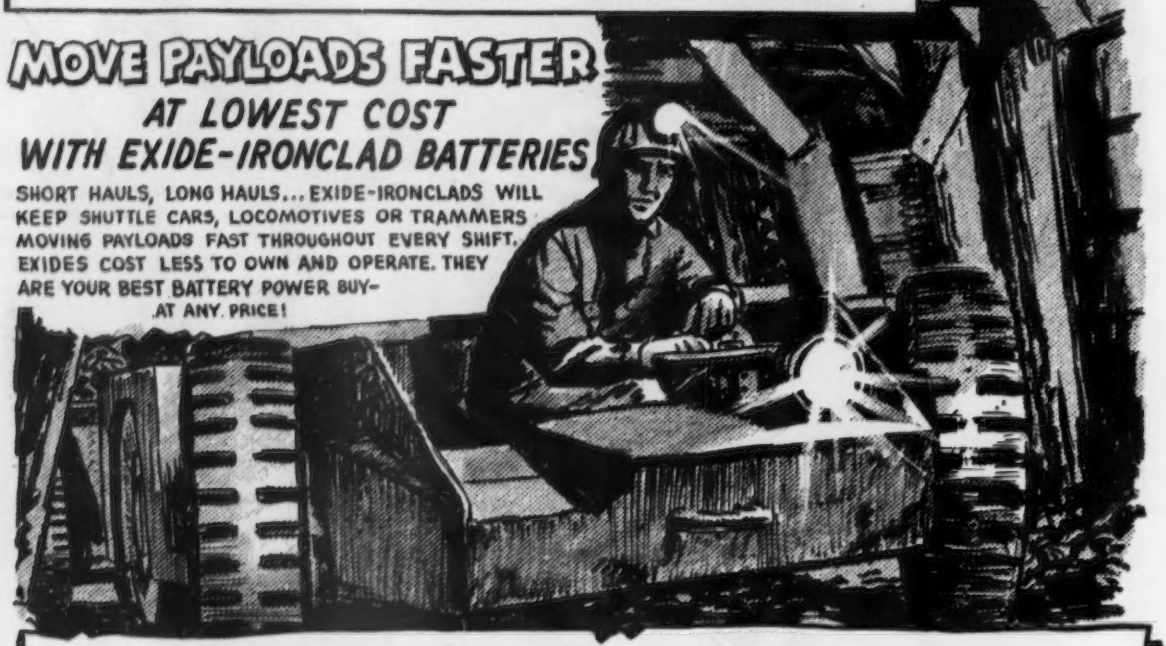
ROEBLING

Subsidiary of The Colorado Fuel and Iron Corporation

JOHN A. ROEBLING'S SONS CORPORATION, TRENTON 2, N. J. BRANCHES: ATLANTA, 924 AVON AVE. • BOSTON, 51 SLEEPER ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 3253 FREDONIA AVE. • CLEVELAND, 13225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4501 JACKSON ST. • DETROIT, 915 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5340 E. HARBOR ST. • NEW YORK, 19 RECTOR ST. • ODESSA, TEXAS, 1920 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • SAN FRANCISCO, 1740 17TH ST. • SEATTLE, 900 1ST AVE. S. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, TRENTON 2, N. J.

FACTS ABOUT Exide®

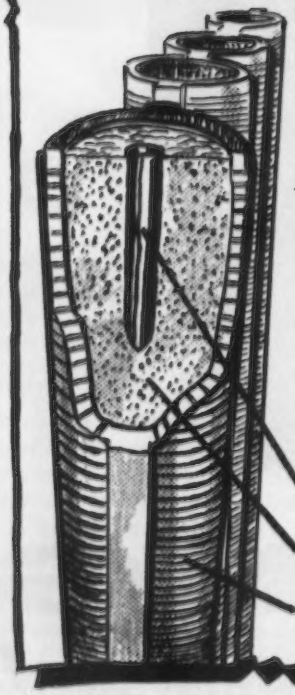
IRONCLAD® MINING BATTERIES



MOVE PAYLOADS FASTER
AT LOWEST COST
WITH EXIDE-IRONCLAD BATTERIES

SHORT HAULS, LONG HAULS... EXIDE-IRONCLADS WILL KEEP SHUTTLE CARS, LOCOMOTIVES OR TRAMMERS MOVING PAYLOADS FAST THROUGHOUT EVERY SHIFT. EXIDES COST LESS TO OWN AND OPERATE. THEY ARE YOUR BEST BATTERY POWER BUY— AT ANY PRICE!

NATURE'S IDEAL SHAPE
THE CIRCLE WORKS FOR YOU INSIDE AN EXIDE-IRONCLAD



SLOTTED TUBES INSIDE AN IRONCLAD KEEP ACTIVE MATERIAL IN FIRM CONTACT WITH CONDUCTING GRIDS OF THE POSITIVE PLATE... THIS GRID PROTECTION LENGTHENS LIFE OF BATTERY. THE SLOTTED TUBES EXPOSE MORE ACTIVE MATERIAL TO THE ELECTROLYTE... FOR GREATER POWER. FINE TUBE SLOTS HOLD MATERIAL IN CONTACT WITH GRID LONGER... RESULT, THE IRONCLAD'S ABILITY TO DO YOUR MINE HAULAGE JOB FOR A LONGER PERIOD OF TIME. THAT IS WHY

EXIDE-IRONCLADS

ARE YOUR BEST MINING BATTERY BUY—

AT ANY PRICE!

IRONCLAD POSITIVE PLATE

LET EXIDE HELP SOLVE YOUR MINING BATTERY PROBLEMS. ❶ CALL AN EXIDE SALES ENGINEER FOR FULL DETAILS. ❷ WRITE FOR FORM 1982, A MANUAL ON MAINTAINING MOTIVE POWER BATTERIES.

Exide INDUSTRIAL DIVISION, The Electric Storage Battery Company, Philadelphia 2, Pa.

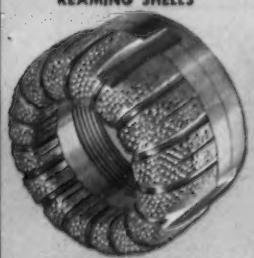
TRUCO CORING BIT

TRUCO CONCAVE BLAST HOLE BIT

TRUCO PILOT BIT

TRUCO IMPREGNATED CORING BIT

TRUCO REAMING SHELLS



TRUCO STANDARD OIL FIELD BIT

FINEST QUALITY DRILL BORTZ

"Bloomin Idol made o' mud— wot they called the Great Gawd Budd"

—KIPLING

The two French soldiers crouched and watched the white little beam of Indian sunlight creep into the eye of the great gilded image across the shadowy chamber. Suddenly, the eye blazed and flashed with brilliant, jewelled fires.

"Diamants!" they whispered, and rushed over and clambered up to the great face. A few moments later they ran out into the turmoil and gunfire in the streets and fled with the rest of the French soldiery, retreating before Captain Clive's victorious Sepoys.

A diamond as big as a walnut and weighing 200 carats isn't the easiest thing to trade, but, eventually, it reached an Armenian dealer who sold it to the Russian Count Orloff for $560,000. The Count diplomatically presented it to the Empress Catherine, who was so pleased that she gave him a half-million dollar grant and another title.

After 200 years, the Orloff Diamond is still one of the world's great jewels. Probably it came from the fabled diamond fields of Golconda which supplied ancient Indian craftsmen with diamonds for their metal-working tools.

And, today, as then, diamonds are still the world's greatest cutting element and in Truco Diamond Bits they provide drillers with the irresistible cutting power for which Trucos are famous—swift, accurate, thrifty, dependable penetration in any formation. Naturally, this cuts rig time and lowers footage costs. May we send you the Truco Drill Bit Catalog?

TRUCO DIAMOND BITS

by

WHEEL TRUEING TOOL COMPANY

3200 W. Davison Avenue, Detroit 38, Michigan

WHEEL TRUEING TOOL CO. OF CANADA, LTD.
575 Langlois Avenue, Windsor, Ont., Canada

MAKE A NEW

World Record

Boulder Crusher AR-180

Six of these huge crushers are being supplied for use underground in Swedish iron mines at Kiruna and Malmberget.

The AR-180 with its 71" x 55" feed opening is the largest single-toggle type Jaw Crusher in the world. It can accept blocks of iron ore up to 10 tons and reduce these to 16" thickness. It can be dismantled into component parts suitable for transportation and erection underground.

Built in three sizes

TYPE	FEED OPENING	SETTING	MIN. MINE SHAFT DIMENSIONS	NETT WEIGHT
AR-120	47" × 35"	12"	36" × 73"	81500 lbs
AR-150	59" × 47"	12"	57" × 89"	170000 lbs
AR-180	71" × 55"	16"	60" × 98"	256000 lbs

Single-toggle design — simple and strong.
Frame in sections, with interlocked bolted joints.
Side frames for the AR-180 and AR-150 are of heavy steel plate.
SKF spherical roller bearings — grease lubricated throughout — avoiding oil leakage. Low idling power consumption.

MORGÅRDSHAMMAR

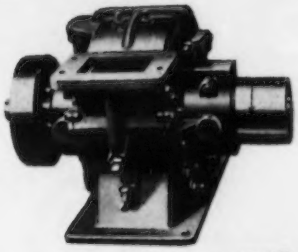
MORGÅRDSHAMMARS MEK VERKSTADS AB • MORGÅRDSHAMMAR • SWEDEN

FINEST QUALITY
DRILL BORTZ

STURTEVANT

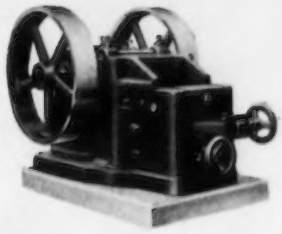
Laboratory Equipment...

assures accurate samples... cuts laboratory sampling costs



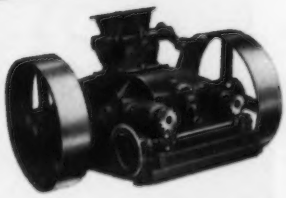
LABORATORY SWING-SLEDGE MILLS

Capable of reducing soft, moderately hard and tough or fibrous materials to any degree of fineness between 1 in. and 20 mesh. The patented "Open-Door" feature permits ready accessibility for cleaning.



LABORATORY JAW CRUSHERS

Special Roll Jaw action simplifies close regulation of the product with capacities varying from 300 to 400 lbs. per hour at finest settings, to 1000 or 2000 lbs. when opened for coarser work. Each part of the crusher is accessible for quick and easy cleaning.



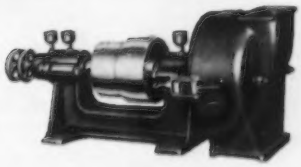
LABORATORY CRUSHING ROLLS

First designed especially for laboratory sampling work, Sturtevant Crushing Rolls are used regularly in many plants where there are limited out-puts. Range of output for the 8 x 5 size is from ½ in. to 20 mesh — and for the 12 x 12 size from ¾ in. to 20 mesh.

Sturtevant laboratory equipment have all the features of full-sized production machines with extra accuracy and wider range of adjustment built-in. They are fast . . . provide true samples of every batch processed.

All Sturtevant machines have "open-door" accessibility which permits quick, thorough cleaning . . . prevents the possibility of previous batches from contaminating new samples. Their rugged construction assures round the clock operation with practically no maintenance.

Investigate Sturtevant equipment for your laboratories. They will help you cut sampling costs . . . improve product quality . . . increase sales. Write for catalog, today.



LABORATORY SAMPLE GRINDER

Laboratory Sample Grinders are of the "Open-Door" disc type and are capable of very fine work, producing products as fine as 100 mesh (coarser if desired) when working on dry, friable, soft or moderately hard materials. Simply turn hand wheel to provide product regulation from 10 to 100 mesh.

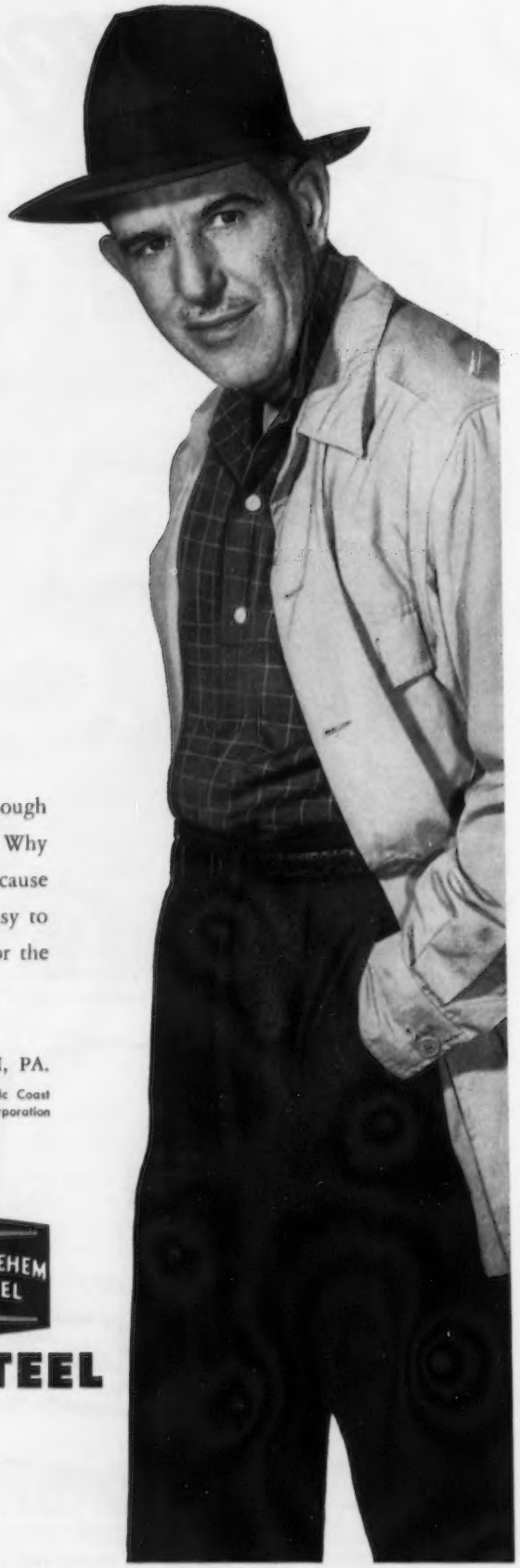
STURTEVANT MILL COMPANY

101 Clayton Street, Boston 22, Mass.

Designers and Manufacturers of

CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS • MECHANICAL DENS and EXCAVATORS • ELEVATORS • MIXERS

"It's good, sound drill steel"



"I've been working with drilling crews long enough to know that it pays to use Bethlehem Hollow. Why do I like it? Well, it's tough, and it saves money because there's little breakage. And my boys say it's easy to heat-treat, whether they use the carbon grade or the alloy. What better reasons can there be?"

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM

BETHLEHEM STEEL

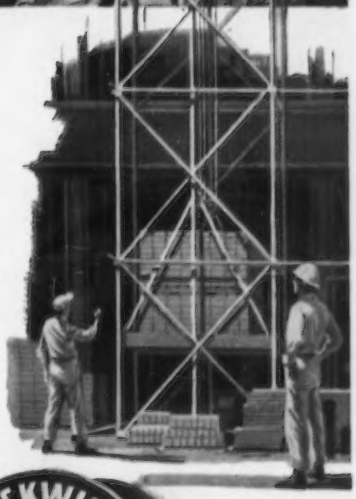
HOLLOW DRILL STEEL

MUSCLES OF STEEL
took the load off his back

Sweat and a strong back just aren't enough when it comes to meeting the stepped-up demands of modern construction work. Today's contractors and builders call on *muscles of steel*—sturdy wire rope—to lift and carry their heavy loads.

Supplying these *muscles of steel* to the giant that is American industry is our big job here at Wickwire—a job that has commanded our vigilant care and painstaking quality control for over half a century.

In the mines and the quarries. In the logging camps and the oil fields. On construction and highway projects. With the fishing fleets and in materials handling. Wherever wire rope is used, Wickwire Rope has earned an outstanding reputation for efficiency, utmost safety, long economical service and unfailing reliability.



every industry benefits from wire rope

WICKWIRE ROPE

CF&I PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

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Wilfley Acid Pump
"COMPANIONS IN ECONOMICAL OPERATION"
Wilfley Sand Pump

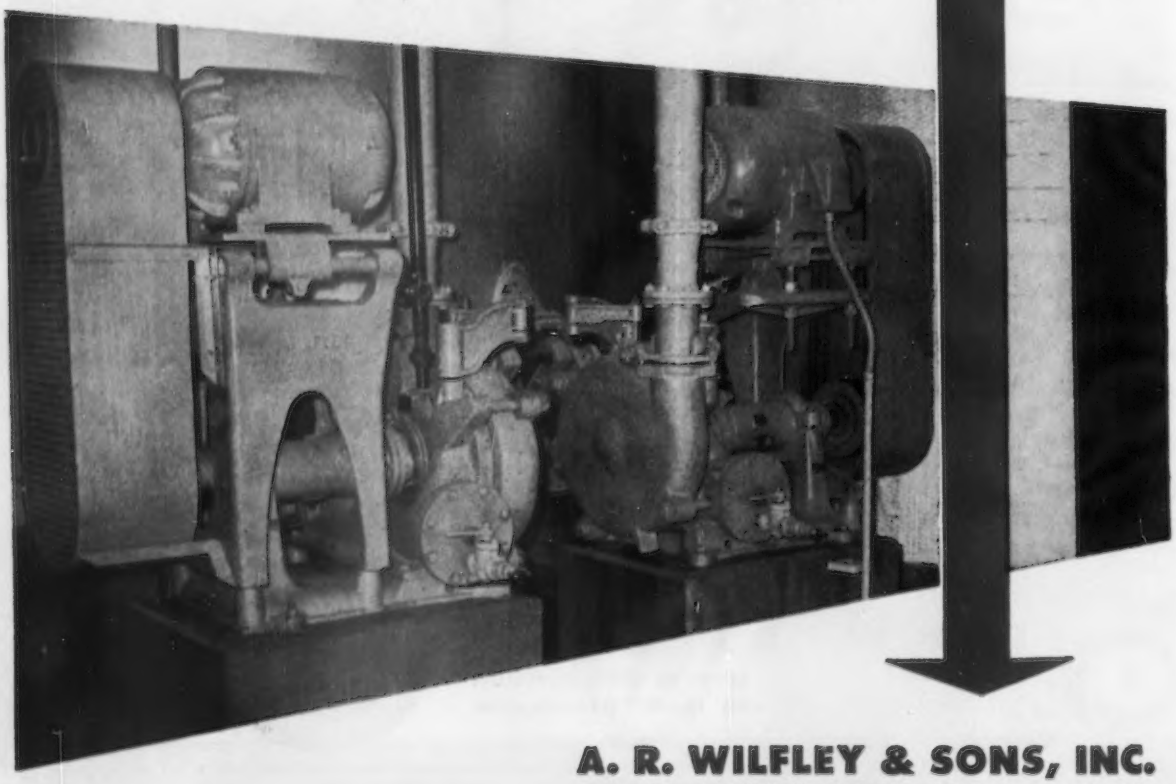
Greater Savings...

WILFLEY
centrifugal PUMPS

through High Efficiency and Economy

Wilfley Model "K" Sand Pumps meet every cost-saving requirement in handling sands, slurries and slimes. These famous pumps definitely increase production and create measurable savings in operating costs. Individual engineering on every application. Write or wire for complete details.

Pictured here is a Wilfley installation in a new potash refining plant. These new Model "K" pumps provide maximum pumping efficiency, even on the most difficult applications.



A. R. WILFLEY & SONS, INC.
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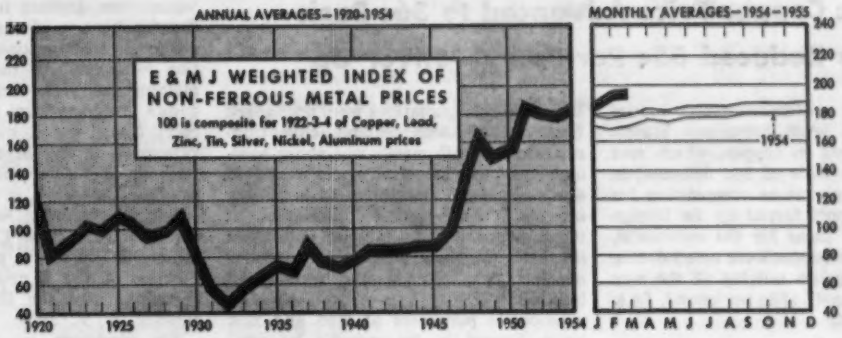
E&MJ OUTLOOK

PRICES



MARKETS

Full impact of 36c copper will not be reflected in *E&MJ's* price index until April averages are available. The index pushed up to a record high of 198.37 for March, 1.3 points higher than for February.

How long will copper remain on its pedestal? Until consumers become aware of mine output increase, already in the making in all major world copper producing areas. Work stoppages, alone, will defer an easier copper supply. Impact should hit in about the third quarter. High copper prices are forcing some consumers to economize and switch to aluminum.

Better efficiency and sustained capacity operation enabled Titanium Metals Corp. to cut sponge prices by 55c. Du Pont followed.

Stability of zinc prices in the current strong market is due largely to the threat of aluminum as a substitute.—One seller nudged the price to 12c.

●

LABOR

Fear of a deadlock in the forthcoming guaranteed annual wage tussle in the automobile industry is waning. Chances for compromise or substitute measures look favorable.

A guaranteed wage headache is on the agenda for mine owners who will have to bargain with Mine-Mill this year. See p. 120.

●

AT HOME

The business boom has hit an all time high for civilian production. Federal Reserve Board's industrial production index for March was 135, as compared with 137 for mid 1953. But the 1953 record was based more on guns than butter. Heavy inventory build-ups foreshadowing a turn back have not appeared on the over-all industrial scene.

Reactor specialists estimate that if uranium were $5 per lb, it would be cheaper to buy new uranium than to reprocess "poisoned" uranium produced in reactors. Efficiency of present reactors is only about ½%.

Rubarite, Inc., jointly owned by Goodyear Co., National Lead, and Bird & Son, Inc., is producing a barite-synthetic rubber product which improves properties of asphalt road-building materials.

Soaring steel production is not being matched by a significant upturn in demand for fluorspar, manganese and chrome ores.

●

ABROAD

U. S. Steel Co. is exploring for manganese in French Equatorial Africa, French West Africa, and Brazil.

American Metal Co. expects to bring the Heath Steele Mines, Ltd. property in New Brunswick into production by late 1957 at about 1500 tons of ore per day.

Moly Corp. has options on 7,900 acres 43 miles southwest of Montreal containing deposits of columbium-tantalum, iron, phosphorus and uranium minerals.

MARKETS—Trends and Prices

Domestic Copper Price Advanced to 36c Basis—Titanium Reduced 55c Per Pound—Silver Up

ACTIVITY in nonferrous metals continued at a high level throughout March. Interest centered in copper, which rose in price to the basis of 36c delivered in the domestic market as competition for the world's supply forced up the foreign market to new highs for the movement. Sales of foreign copper were noted during the month at prices ranging all the way from 32.775c to 45.888c per pound, f.a.s. N.Y. equivalent.

Fabricators and producers met with officials of the Business and Defense Services Administration to review the copper situation, particularly in reference to exports, production, and possible relief through deferment of stockpile deliveries. The authorities released copper to industry that would have moved into the stockpile in the April-June period. Those producers who had agreed previously to return copper released to industry in the closing months of 1954 by June 30, 1955, now have until March 31, 1956, to take care of such stockpile commitments.

Mine output of copper, here and abroad, should increase substantially in 1955, providing that work stoppages do not harass the industry. U. S. mine output in the first two months of the current year was at the annual rate of just a little under 1-million tons. As production rises, the scare buying is bound to end, market authorities maintain. This could happen in the third quarter of the year, or as soon as the price situation shows any signs of easing. Some important producers believe that current quotations for copper are too high for the good of the industry.

Copper's rise to 36c was accomplished over a period of three days. Phelps Dodge took the initiative by announcing that its price would be 36c per pound, beginning with March 29. Anaconda followed almost immediately and other producers, excepting Kennecott, tagged along. By March 31 Kennecott also moved up to 36c, with the market still strong because of the squeeze in the European market. Foreign consumers paid as much as 45c on scattered lots of nearby metal. However, all foreign producers of copper did not follow the sharp rise in foreign quotations.

Cash copper on the London Metal Exchange rose from £341½ bid on March 1 to £363½ bid on March 31. The three-months' position advanced from £331 per long ton (first session) on March 1 to £354½ as the month ended. Sharp criticism of the Exchange continues and a number of fabricators who had been buyers of copper on the LME quotations have stopped pricing the metal on that basis.

Lead and zinc quotations were unchanged for the month, with demand active. Consumption of both metals was above average in volume. Domestic prices were held down because of the threat of increasing imports. Though actual consumption of these metals has been rising outside of the U.S., the price structure abroad has not yet reflected the improvement in business.

Stockpile purchases of lead and zinc again figured in the month's business. After the present U.S. program ends on June 30, 1955, the industry looks for continued support in one form or another to maintain production at U.S. mines. A measure has been introduced in the form of an amendment to H.R.1 (Trade Agreements Act) that would impose a 2c tax on imports of lead and zinc in addition to existing duties should lead fall below 15c and zinc below 13c.

Mine production of zinc in January was estimated at 41,518 tons, up 5% from a year ago. Domestic mine production of lead in January was 27,837 tons, up 12% from a year ago. Stocks of slab zinc in the U.S. have been reduced by 52% over the last year.

Aluminum producers appeared satisfied over a decision of the Government to reduce by 75,000 tons the stockpile "take" for the first half of 1955. This should ease the existing shortage in the aluminum supply. U.S. production in February was 116,236 tons against 128,203 tons in January. The daily rate of production for February was slightly higher than that of January. Unlike deferment of copper for the stockpile, aluminum producers need not replace the metal at a later date. Aluminum producers have "put" clauses in their stockpile contracts, which allows them to ship when industrial demands are down. In fact, they did ship rather large tonnages to the strategic reserve during 1954. To conserve supplies, second-quarter aluminum scrap exports have been limited to 9,000 tons, the Bureau of Foreign Commerce announced March 28. Primary aluminum prices remained unchanged in March, but scrap and secondary metal rose sharply.

Titanium Metals Corporation of America took the initiative in reducing the price of titanium sponge metal 55c per pound, effective April 1. Du Pont met the decline. This establishes the quotation on Grade A-1, the top grade, at $3.95 per pound, and on Grade A-2 $3.50 per pound. On the last-named grade the decline in price amounted to 50c.

In announcing the decline, Titanium Metals said the latest reduction in the price is greater than the total of all previous price declines in the five-year industrial history of the metal. Growing efficiency and sustained capacity operation were cited by the company in explaining the price reduction. The company's production plant at Henderson, Nev., it was stated, has developed innovations permitting large-scale output with promise of future price declines as expanding know-how is put into practice.

Magnesium metal was advanced 1½c per pound by Dow Chemical, effective March 21. Primary pig, 99.8%, f.o.b. Freeport, Texas, is now quoted at 28½c per pound; Madison, Ill., 29.7c; and Port Newark, N. J., 29.9c.

Tin producers see further delay in ratification of the International Tin Agreement. The Senate group named to review the tin situation here and pass on the future of the Texas City tin smelter has asked for more time to report on the project. It now appears that the group's recommendations may not be made public before April 30. As a result there is general confusion within the

Average Prices for March (E&MJ Quotations)

Copper:	
Electrolytic, domestic refinery	32.935
Electrolytic, export, refinery	37.314
Lead:	
Common, New York	15.000
Common, St. Louis	14.800
Silver and sterling exchange:	
Silver, New York, per oz.	87.250
Silver, London, pence per oz.	75.902
Sterling Exchange, "Checks"	279.143
Zinc:	
Prime Western, East St. Louis	11.500
Prime Western, delivered (g)	12.000
Tin:	
New York Straits	91.106
New York, 99% min. (e)	90.106
Gold, per oz. U.S. price	$35.000
Quicksilver, per flask	$321.556
Antimony (E&MJ) (d)	31.970
Antimony, bulk, Laredo	28.500
Antimony, in cases, Laredo	29.000
Platinum, refined, per oz.	$78.500
Cadmium (a)	170.000
Cadmium (b)	170.000
Cadmium (c)	170.000
Aluminum, 99% plus ingot	23.200
Magnesium, ingot	27.556
Nickel (f)	64.500

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.
(a) Cadmium average based on the producers' quotations.
(b) Cadmium average based on the average of the producers' and platers' quotation.
(c) Cadmium average based on platers' quotation.
(d) Domestic, 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(e) Tin content.
(f) F.o.b. Port Colborne, U.S. duty included.
(g) Delivered where freight exceeds 0.5c.

Markets Continued on Page 106

industry and the market outlook as uncertain, with dealers on the sidelines. Prices in recent months have shown little net change, holding around 91c.

Quicksilver prices were unsettled on freer offerings. Consumption in established outlets has been falling because of high prices. Production is increasing.

Silver of foreign origin advanced sharply on March 15 to 89¾c an oz troy, the first price change since Jan. 16, 1953. An unexpected shortage developed as the Bank of Mexico withdrew offerings on the strength of the sale of 17-million oz to Saudi Arabia for coinage purposes. Demand at the higher level slowed down and the price on March 18 declined to 88½c, continuing at that level over the remainder of the month.

"Free" Gold Market

Price developments in the European market for "free" gold were few, with no pronounced changes. In the Far East prices tended to rise. The volume of business rose in March by about 13% over February. No Russian sales were reported. Pick's World Currency Report quotes on "free" gold, per fine oz, as follows:

	COINS		BARS (12.5 kg)	
	Feb. 28	Mar. 31	Feb. 28	Mar. 31
NEW YORK, transit	.....	.....	$35.10	$35.10
MANILA	$40.25	$40.00	37.50	37.25
HONG KONG	39.90	39.85	38.00	37.95
BOMBAY	50.25	53.00	49.50	52.50
TANGIER	39.30	39.25	35.05	35.05
BEYROUTH	40.10	40.00	35.22	35.20
PARIS	39.50	39.50	35.70	35.80
BUENOS AIRES	40.25	42.50	38.50	38.75

Note: All prices are computed at the free or black market value of the U.S. dollar in the local markets.

Major Metals

U. S. DAILY AND AVERAGE PRICES

Mar. 1955	Electrolytic Copper (a) Domestic	(b) Export	Straits Tin New York	Lead New York	Lead St. Louis	Zinc Delivered (f)	Zinc East St. Louis
1	32.700	36.025	91.125	15.000	14.800	12.000	11.500
2	32.700	36.025	91.000	15.000	14.800	12.000	11.500
3	32.700	36.150	90.875	15.000	14.800	12.000	11.500
4	32.700	34.800	90.875	15.000	14.800	12.000	11.500
5	No Market	35.775	90.875	15.000	14.800	12.000	11.500
7	32.700	36.300	90.750	15.000	14.800	12.000	11.500
8	32.700	36.000	90.625	15.000	14.800	12.000	11.500
9	32.700	35.700	91.250	15.000	14.800	12.000	11.500
10	32.700	38.625	91.250	15.000	14.800	12.000	11.500
11	32.700	38.550	91.250	15.000	14.800	12.000	11.500
12	No Market	38.550	91.250	15.000	14.800	12.000	11.500
14	32.700	38.825	90.625	15.000	14.800	12.000	11.500
15	32.700	38.835	90.625	15.000	14.800	12.000	11.500
16	32.700	38.580	91.125	15.000	14.800	12.000	11.500
17	32.700	36.475	91.250	15.000	14.800	12.000	11.500
18	32.700	38.775	91.375	15.000	14.800	12.000	11.500
19	No Market	36.575	91.375	15.000	14.800	12.000	11.500
21	32.700	36.250	91.250	15.000	14.800	12.000	11.500
22	32.700	37.950	90.875	15.000	14.800	12.000	11.500
23	32.700	39.000	91.500	15.000	14.800	12.000	11.500
24	32.700	36.350	91.000	15.000	14.800	12.000	11.500
25	32.700	37.675	91.375	15.000	14.800	12.000	11.500
26	No Market	36.575	91.375	15.000	14.800	12.000	11.500
28	32.700	38.300	91.375	15.000	14.800	12.000	11.500
29	34.000	36.575	91.250	15.000	14.800	12.000	11.500
30	33.800	39.250	91.125	15.000	14.800	12.000	11.500
31	35.700	38.975	91.250	15.000	14.800	12.000	11.500
AVERAGES FOR MONTH							
Mar.	32.935	37.314	91.106	15.000	14.800	12.000	11.500
AVERAGES FOR WEEK							
Mar.							
2	32.700	36.238	91.188	15.000	14.800	12.000	11.500
9	32.700	35.788	90.875	15.000	14.800	12.000	11.500
16	32.700	38.661	91.021	15.000	14.800	12.000	11.500
23	32.700	37.504	91.271	15.000	14.800	12.000	11.500
30	33.180	37.454	91.250	15.000	14.800	12.000	11.500
CALENDAR WEEK AVERAGES							
Mar.							
5	32.700	35.725	90.979	15.000	14.800	12.000	11.500
12	32.700	37.288	91.063	15.000	14.800	12.000	11.500
19	32.700	38.011	91.063	15.000	14.800	12.000	11.500
26	32.700	37.300	91.229	15.000	14.800	12.000	11.500

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Mar. 1955	Sterling Exchange "Checks"	Silver (c) New York	Silver London	Gold London	Gold (d) United States
1	278.6171	85.250	74.250d.	251s. 7½d.	$35.00
2	278.9453	85.250	74.250d.	251s. 5½d.	35.00
3	278.8710	85.250	74.250d.	251s. 3½d.	35.00
4	278.9375	85.250	74.250d.	251s. 3½d.	35.00
5	(e)	(e)	(e)	(e)	35.00
7	278.9375	85.250	74.250d.	251s. 3½d.	35.00
8	278.9687	85.250	74.250d.	251s. 3d.	35.00
9	279.0781	85.250	74.250d.	251s. 3½d.	35.00
10	278.9921	85.250	74.500d.	251s. 3d.	35.00
11	279.1601	85.250	74.500d.	251s. 2d.	35.00
12	(e)	(e)	(e)	(e)	35.00
14	279.2500	85.250	74.750d.	251s. ¼d.	35.00
15	279.3125	89.750	75.500d.	251s. 0d.	35.00
16	279.2617	89.750	77.500d.	251s. 0d.	35.00
17	279.2187	89.750	77.500d.	251s. ½d.	35.00
18	279.2187	88.500	77.500d.	251s. ½d.	35.00
19	(e)	(e)	(e)	(e)	35.00
21	279.2656	88.500	77.250d.	251s. 1d.	35.00
22	279.3125	88.500	77.250d.	251s. ¼d.	35.00
23	279.2812	88.500	77.250d.	251s. ½d.	35.00
24	279.2187	88.500	77.250d.	251s. 1d.	35.00
25	279.3046	88.500	77.250d.	251s. 1d.	35.00
26	(e)	(e)	(e)	(e)	35.00
28	279.2410	88.500	77.000d.	251s. 0d.	35.00
29	279.2734	88.500	77.000d.	251s. ¼d.	35.00
30	279.3125	88.500	77.000d.	251s. ½d.	35.00
31	279.3007	88.500	77.000d.	251s. ½d.	35.00
AVERAGES FOR MONTH					
Mar.	279.143	87.250	75.902	—	35.00
AVERAGES FOR WEEK					
Mar.					
2	278.725	85.250	—	—	—
9	278.959	85.250	—	—	—
16	279.196	87.050	—	—	—
23	279.259	88.750	—	—	—
30	279.270	88.500	—	—	—

Calendar Week Averages: New York Silver: Mar. 5th, 85.250; 12th, 85.250; 19th, 88.600; 26th, 88.500.

(e) No Market (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.300c per pound, the average differential for delivery charges.

(b) Our export quotations for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.075c for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingotbars; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West, effective Jan. 1, 1951, commanded a premium of 1.35c per pound over the current market for Prime Western; Special High Grade 1.50c.

(f) Prime Western delivered where freight from E. St. Louis exceeds one-half cent.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 points.

(c) The daily silver quotation reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually one quarter cent below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5 per troy ounce 1000 fine, effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U.S. Treasury's gold price. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

Behind the By-Lines . . .

G. P. Lutjen

"Titania est omnia divisa in partes tres," as Julius Caesar, a former sports writer, so aptly put it. Freely translated,—"There are three different schools of thought on titanium's future". These are known as the Mink, Sink and Blink Schools of Titanium Thinking.

Mink Thinkers: Enthusiastic. Regard titanium as greatest thing since instant bourbon. Convinced that anyone getting into titanium now, will wind up wearing mink shirts, counting profit in megadollars.

Sink Thinkers: Momentarily expect entire titanium industry to go down the drain. Given to sneering and catcalling when "wonder metal" is mentioned. Wouldn't wear a mink shirt anyway.

Blink Thinkers: So called because of characteristic response to titanium questions; a series of blinks followed by "Well, er." Cagey. Waiting to see which way ball bounces. Frequently found with ear to ground.

Minker, Sinker or Blinker, you're in for profitable and startling reading in "What the Future Holds for Titanium", starting on p 72. Author Herbert H. Kellogg is not only a competent metallurgist and shrewd analyst, but he is one of the very few men in the country who has had the opportunity to study the various titanium metal projects at close range. This intimate acquaintance with processes, techniques and costs, gained as chairman of the Government's Titanium Advisory Committee, enables him to make a series of sound predictions on the industry's future. If you're thinking of investing your career, your company's effort or just money in titanium, this is for you.

One of the dirtiest tricks since Delilah opened her small barber shop, was perpetrated on us this month by the titanium industry. Just as the titanium story (See above and p 72) went to press, somebody lowered the price of titanium sponge from $4.50 to $3.95 per lb. Fortunately, it doesn't upset the story—only us—and if you will read the new price into the spots where the old price appears, we'll be much obliged.

When it comes to mining booms, Canada takes a back seat to nobody. When you note that mineral production was a mere $423-million in 1939 and hit $1,041-million in 1954, you get a small idea of why Canadian mining men are bullish. Nor is there any sign of exploration slowing down. Targets are expanding from gold, silver and base metals to include uranium, lithium, asbestos, iron, mercury and countless other commodities which can be mined for fun and profit. Exploration techniques are being developed, expanded, combined and otherwise parlayed to a new high in efficiency. And thereby lies the tale that you will find starting on pp 96 and 97, under the title, "Unprecedented Exploration Programs Expand Canada's Mineral Wealth."

Washington is the latest state to jump on the uranium bandwagon and it is safe to say the boom is on. You'll find all the details on page 122 with the exception of railroad and airline schedules to Spokane. One point we'd appreciate some enlightment on is the statement that one find was made by an "Opportunity dentist." We can't decide whether an Opportunity dentist is a Northwest expression for "geologist" or a live wire who decided that there's more money taking uranium out of holes in the ground than putting gold into holes in the teeth.

Inspirational Poems are one of the terrible prices we pay for letting people learn about rhyming and such; especially self-made people. Self-made people are always tossing Inspirational Poems at run-of-the-mill type people, and we're getting tired of it. After several years of stewing under this indignity, we have at last discovered an Inspirational Poem of our own, which we hereby offer to our run-of-the-mill colleagues for whatever comfort it might be.

They told him it couldn't be done.
With a smile, he set right to it.
He tackled this thing that couldn't be done,
And couldn't do it.

Except in February which is a ridiculously small month, a new record seems to be broken every time aluminum production figures are published. If it isn't the "biggest 2nd quarter in the history of the industry," it's the "biggest 23rd week" or even the "biggest Thursday afternoon." We admire this elán in the vigorous growing industry and aluminum producers can be justly proud of their growth and what it stands for. But with the surpassing of copper production on a tonnage basis last year, we feel that aluminum is emerging from boyhood into manhood, and it's about time it started wearing long pants. In our largest tonnage non-ferrous metal industry, why is production still measured in pounds?

We have been told by aluminum people that this quaint measuring device is a hangover from days when aluminum was small potatoes and production reports looked bigger and better in pounds. In 1955, the need for subterfuge has passed. Aside from eliminating the minor chore of dividing everything the aluminum industry says by 2000, aluminum deserves recognition as a *tonnage* industry.

You can say what you want about the political ups and downs of the French, but when it comes to the aesthetic, they're the most. For example, who else but the French would paint the Eiffel Tower, if they had one, in three shades of cognac brown? We really can't vouch for other countries but if anything got painted cognac brown in the US, the odds are 4 to 1 that it was the work of a publicity man on behalf of the distilling interests. In France the motivation is refreshingly pure—cognac brown is considered the perfect complement to the Paris sky. We're avec vous, mes amis.

ENGINEERING AND MINING JOURNAL

APRIL 1955

It's Time Now to Recruit Engineers for the Future

WEEK AFTER WEEK the Sunday *New York Times* carries pages of advertisements in which some of the nation's largest industrial firms offer attractive jobs to engineers of all types—metallurgical, electrical, mechanical, chemical, ceramic, electronics, etc. The continued frequency of these advertisements shows that competitive bidding for engineering talent is intense, also that the recruits are often sought for such long-range projects as the development of nuclear energy and related equipment.

Now if the mining industry were not faced with long-range research and development objectives, there would be no cause for alarm about the supply of engineers for the future. But that is not the case. The whole titanium industry, so ably analyzed by Prof. H. H. Kellogg in the following pages, can prosper or drag its feet depending upon the success of the research and engineering teams engaged in solving some of the baffling metallurgical problems involved. In fact some experts believe that ultimately titanium will be produced by some process not now known or in use.

"Operations Research" which is playing such an important part in industrial development is now invading the mining industry. One large company producing a highly competitive industrial mineral has applied modern research to such a fundamental problem as planning dragline operations, and has come up with astonishing answers.

Annual reports of major mining companies now being released to stockholders are loaded with items about new research objectives and accomplishments. For instance, Kennecott Copper Co.'s Western Research Center has developed and improved a metallurgical technique which will increase recovery of copper from Ray ore from 17 to 19 lb per ton.

In the face of this surge for added engineering talent we find that 300 mining engineers graduated in 1954; only half as many as are expected to graduate in 1956.

We think that the AIME is fortunate in having H. DeWitt Smith as president because he recognizes the danger of the apathy of the mining industry toward the recruiting of new engineering talent. In a Mining Branch luncheon at Chicago recently, he said, "It's up to the mining companies to make financial remuneration and opportunities for advancement more attractive if mining is to hang onto the technical people it has, or attract the young men it urgently needs."

Speaking again of salaries, he said, "A good many mining companies are still paying 1945-sized salaries, yet the scale of living of mining engineers . . . has changed considerably from 1945 to1955."

Attractive living quarters are also essential to a recruiting program. Fortunately this aspect is getting greater emphasis in modern mine properties, but there is still room for improvement. The Colorado Plateau in particular may have a high personnel turnover if the housing problem is not solved satisfactorily. One firm of consultants has made a brief survey of mine townsites, and concluded that much can be done to make mine life more livable. See news item p 123.

Summing it up, we believe that the mining industry may find itself in a jam if it does not gage the future need for engineering talent accurately. Secondly, it's time right now to tell potential engineers that it has a place for them, and that it will match the bids of industrial firms now siphoning off the limited supply into other fields.

One final remark: Research and engineering should not be charged off as overhead. It is and can be regarded as an investment, paying such handsome dividends as two pounds more recoverable copper for every 17 lb heretofore recovered.

Titanium's Future

This is how the industry shapes up now		This is how Kellogg sees it at maturity
Rutile is prefered for easier metallurgy (no iron) despite higher cost per lb Ti. Slag (70% TiO_2) from ferruginous ilmenite is semi-experimental.	ORE	Slag (80% TiO_2) from ferruginous ilmenite. It's more abundant than rutile; has less iron than ilmenite ore though higher in price.
$4.50 per lb.	SPONGE	$1.15 per lb., including raw material.
	INGOTS	$1.30 per lb.
Forging billet .....$ 9.00 per lb. Plates ..... 12.00 per lb. Sheets ..... 15.00 per lb.	MILL PRODUCTS	Forging billet .....$1.78 per lb. Plates ..... 2.06 per lb. Sheets ..... 2.34 per lb.
5,000 tons sponge production in 1954.	U.S. PRODUCTION	200,000 tons per year by Kroll process or derivatives. 400,000 tons if "new" process develops.
Largest plants, 3600 tons per year sponge capacity. One of these is negotiating with GSA for an increase to 10,000 tons per year.	PLANT SIZE	Individual integrated plants will have capacities in the range of 20,000 to 40,000 tons per year.

What the Future

H. H. KELLOGG
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New York, N. Y.

(Effective April 1, price of titanium sponge is $3.95 per lb, according to an announcement received as this issue went to press.—Ed.)

A PROMINENT METALLURGIST in a recent speech with great aptness described titanium as "a most vexatious metal." Titanium's notorious ability to disolve its own oxide in the solid state, and to form stable carbides, nitrides, and hydrides is most vexing to the metallurgist who is concerned with production or use of the metal. These properties are responsible for most of the complex and exacting reduction, melting, and fabricating methods that must be used to make useful products from titanium.

Vexation of the aircraft industry, as one of the major potential users of titanium, is easily understood. To the designer of airframes and engines the unusual properties of titanium (see Table 1) offer the promise of improved performance for his products. But the man called upon to produce aircraft products containing titanium must deal with a very expensive material, available in limited supply, in variable quality, and for which fabrication "know how" is yet to be developed.

Titanium is vexatious to our Government. Far-sighted leaders in the Armed Services have seen that titanium, were it available in quantity and at a reasonable price, could be used to make weapons of superior performance. They have seen that the security of our country, to some extent, may well be affected by our ability to make and use titanium effectively. The vexation arises from details of implementation of a Government program to encourage the titanium industry: Which processes should be used? What quality of titanium is necessary? How much should be stockpiled? How much titanium will we need three years from now? Can cost be cut?

Finally, titanium is vexatious to businessmen seeking new fields for investment capital. On one hand these men hear and read of "titanium, the wonder metal" and the "titanium age" to come. On the other hand they hear that the future importance of titanium has been vastly overrated; that the metal will remain a high-cost product with limited usefulness. Although all titanium now produced on a commercial scale is made by the Kroll process (or some modification thereof) and sells for $4.50 per pound in the sponge form, businessmen are continually pressed by inventors of "new" processes with the claim that titanium sponge could be made for less than $1.00 per pound. Will the Kroll process, then, become obsolete in the near future?

My analysis of the situation reveals:

1. That present vexations, problems and doubts concerning titanium result from the infant nature of the industry, rather than from inherent shortcomings of titanium itself.

2. That, even though improved

Kellogg's Past

Herbert H. Kellogg

"What the Future Holds for Titanium" represents one man's personal views. But this man is one of the very few in the country in a position to acquire the intimate acquaintance with the titanium industry which is needed to project its future on a sound basis.

In February 1954 Herbert H. Kellogg was appointed chairman of the Government's Titanium Advisory Committee by Arthur Flemming, Director of Defense Mobilization. Chief responsibility of the Committee was, and is, to examine the titanium situation and advise the Government as to how it might best help develop the industry. Other committee members are A. J. Phillips, vice president, American Smelting and Refining Co., and Felix Wormser, Assistant Secretary of the Interior.

Prof. Kellogg devoted his full time to the committee until August 1954, when he returned to his position of Associate Professor of Mineral Engineering at Columbia University where he has been located since 1946. He has remained chairman of the committee however, on a part time consultant basis, and averages a day a week in Washington.

Author of numerous technical papers on various aspects of metallurgy, Prof. Kellogg was one of the founders and first chairman of the AIME's Committee on Physical Chemistry of Extractive Metallurgy. He is now chairman of the Institute's Electrolytic Extractive Processes Committee.

Holds for Titanium

processes might well be developed, the Kroll process has been seriously underrated by its critics.

3. That even without major improvements in technology it should be possible to produce titanium mill products for about $2 per lb when the industry has matured. At that time the industry will have grown to a peacetime capacity of several hundred thousand tons per year in the United States alone.

The Infant Titanium

The titanium metal industry is barely six years old. In 1948 a little over two tons were produced. Largely as a result of the Government program, whereby guaranteed loans and accelerated tax amortization have been granted to the industry, sponge production has grown to about 5,000 tons in 1954, with a forecast production of 8,000 to 10,000 tons for 1955.

Over the last six years the price of sponge titanium has dropped somewhat as production increased. Until 1954 a price of $5 per lb prevailed for all qualities of titanium sponge. Early this year the price was down to $4.50 per lb for the highest grade (A-1) of sponge and $4 per lb for a slightly less pure grade (A-2). This is not a substantial reduction. Unless the detailed history of these past six years is carefully analyzed, it might be concluded that titanium production by the Kroll process is inherently a high-cost process, and that the only hope for low-cost titanium is a new "continuous process."

Is $4 titanium sponge the best that can be expected from the Kroll process? Will it take a radically new and improved process to make $1.15 titanium sponge? Or will the new processes allow production of $0.80 sponge against $1.15 sponge by the Kroll process? I think the last of these possibilities is the most likely.

As a research metallurgist, I am partial to new processes, and in the case of titanium I believe it most likely that new processes will be developed which will prove superior to the present adaptations of the Kroll process. I have seen several laboratory and pilot-plant developments which are most encouraging for the future. A full-scale sodium reduction plant is under construction, and several other sodium reduction processes are in the pilot-plant stage; several different electrolytic processes are under study in pilot plants; an improved iodide-reduction process is almost ready for commercial-scale production. But I feel far from certain that the future of low-cost titanium is dependent upon these developments.

Why the Price is So High Now

Analysis of the reasons for today's high prices for titanium should begin with a summary of these prices. Table 2 shows the present market prices of titanium ores and products.

To understand the tremendous spread in price between titanium in the form of ore 3-10c per lb and titanium metal in fabricated form ($9-15 per lb), it is as necessary to under-

Table 1. Properties of Alloyed Titanium Compared with Stainless Steel and Aluminum Alloy

	Aluminum 75S	Titanium 6A1-4V	Stainless Steel 321
Density, grams per cc	2.8	4.5	8.0
Tensile strength, wrought products			
Annealed, psi	33,000	130,000	85,000
Heat treated, psi	82,000	190,000**	150,000*
Strength-weight-ratio, wrought products			
Annealed (psi/lb cu in.)x10^{-4}	33	80	29
Heat treated, (psi/lb cu in.)x10^{-4}	81	117**	52*
Max. service temp., deg F	400	800	1600

*Cold rolled
**Not yet developed on a commercial scale

stand the economic and political background of the titanium industry as it is to understand the detailed costs of manufacture. Perhaps the most unusual feature of this general background is the nature of the current market for titanium. The U.S. Government is the ultimate consumer of more than 90% of all titanium used today. This situation has arisen in the following way:

The first years of the titanium industry resulted in a small output of metal—of doubtful quality—which sold at high prices because of the experimental nature of the industry. Uncertainties of supply and quality and excessive price were such that potential commercial consumers could not justify use of the metal for production purposes. Industry had lived without titanium and had prospered. With few exceptions, apparently, industry felt it could continue to live without titanium until a time when prices would be lower and production more certain.

The Pioneers

At the same time, the Air Force, the Navy Bureau of Aeronautics, and various companies which build airframes and jet engines for the Armed Services realized that if titanium were widely used in airplane construction, substantial performance improvement would result from its light weight and heat resistance. The view has often been expressed, and is undoubtedly justified, that the failure to make a supreme effort to foster production and use of titanium for military aircraft at this time would have risked the security of our nation. The excessive price of titanium, therefore, was not allowed to stand in the way of security, and thus, the U.S. Government became the only major potential consumer willing to pay the high price for a new metal.

The Government program of underwriting a rapid expansion in the titanium sponge industry, of stockpiling titanium sponge, and of sponsoring numerous research projects on titanium was, and is, based primarily on the potential demand of the military aircraft industry.

Record Expansion

Much has been accomplished in the less than four years that this program has been in effect. Never before has the production of a new metal been expanded so rapidly. Along with quantity of production, quality of the metal produced has improved to the point where the "good" metal of 1952 is almost worthless by 1955 standards. But prices have dropped only slightly and consumption by the aircraft and jet engine industry has failed to grow as rapidly as was expected.

Partial failure of the Government program to achieve a large production of low-cost titanium does not result from the failure of titanium to live up to its expected properties in performance. Low density, the fact that it retains most of its strength to 800 deg F, fatigue, creep, and strength-weight ratio of the important titanium alloys, excellent corrosion resistance, are all matters of proven laboratory fact. And we can expect that new research in titanium alloys will result in improvement of these properties.

Lack of industrial "know-how" in melting and fabricating titanium products stands in the way of wider use in aircraft. By concentrating attention on the admittedly difficult task of producing titanium sponge from ore, difficulties confronted in fabrication have been overlooked. A wholly new set of conditions for rolling, forging, casting, machining, cutting and forming titanium has to be understood and introduced as shop practice in those industries which are to use titanium. Some of this "know-how" is now available; much is yet to be learned.

Prices of titanium metal products have remained high not because they are close to the minimum costs attainable with the Kroll process and current practice in consumable-arc cold-mold melting, but because of the infant nature of the industry. Reasons for today's high prices other than those inherent in the manufacture of titanium, are given below.

1. Rapid amortization of plant costs is necessary because of the probability of early obsolescence of present methods. Almost without exception, companies making sponge and companies that melt and fabricate titanium have been granted the right to use five-year accelerated tax amortization for their facilities.

2. Research and development expenses are excessive because of constant pressure for improved product quality, and need to investigate new or modified production processes. Fear of obsolescence of present methods adds to the need for research on new processes.

3. Off-grade product may represent a sizeable fraction of total plant output. This material represents a complete loss to the company, since refining methods for off-grade product have yet to be developed. The large fraction of off-grade product that plagues both sponge and mill-product production may be attributed to the lack of production experience and "know-how," which will only be obtained with maturity of the industry.

4. High-price skilled technical help is required in larger than usual percentage of the payroll to cope with problems of improved product quality and modified production procedures.

5. Volume of production is small and uncertain, with resultant high costs. Largest titanium sponge plant now in operation has a capacity of 3,600 tons per year. It has been operating at capacity for only a few months, not long enough for the benefits of capacity operation to be reflected in reduced prices. A 3,600-ton plant is small. Even if operated at capacity, its costs are considerably

higher, relatively, than the costs will be of the large-scale plant of the future.

Since consumption of titanium products by the aircraft industry is lagging considerably behind the rate of sponge production (about 2,000 tons of sponge was used in 1954 against a production of 5,000 tons), the scale of operation in titanium melting and mill-product fabrication is even smaller than in the sponge industry. A large portion of the orders for mill products are for experimental or prototype purposes, which means the mill must handle numerous small orders on a custom basis. No company has yet found it feasible to build an integrated plant solely for melting and fabrication of mill products because of the small volume of orders.

Integration Needed

Common procedure today is to have a small titanium melt shop near a stainless steel fabrication plant, and to forge, condition, and roll titanium only when it can be fitted into the stainless steel schedule. This practice, necessary as it is today, not only results in skyrocketing costs, but also exacts a penalty from the quality of the product. Perhaps the largest single reduction in costs, and improvement in quality, may be expected when the volume of titanium consumption justifies integrated melting and fabricating facilities, specifically designed for titanium.

6. Retreatment of titanium scrap on a large scale has not been possible for a number of reasons. This has resulted in high mill-product prices because the fabricator is unable to re-use at least part of his scrap. Cost to the aircraft producer using titanium is increased further because no market exists for the scrap he produces.

Progress on scrap utilization, however, has been rapid in the last year. Furnaces designed to handle odd scrap shapes are under development. Considerable improvement in sponge quality in recent months will permit greater use of partly-contaminated scrap. Scrap refining processes are being developed. Several years from now, when full scrap utilization is achieved, considerable reduction in the price of titanium mill products should result.

7. The military aircraft market, to which more than 90% of titanium production now goes, makes the utmost demands in product quality. This market is also uncertain to the extent that the state of national preparedness fluctuates with world politics. When less exacting markets develop, volume of production should increase and prices decrease.

These problems all result from unusual conditions surrounding the growth of this new industry. It is reasonable to assume that the price of titanium products will drop and that consumption will increase as time cures these problems one by one. An early history of high prices, difficulties in production and low production rate is not peculiar to titanium alone—it was true of aluminum near the turn of the century, and of stainless steel only a generation ago. Titanium has the advantage of strong financial backing from the Government. This will certainly shorten the growth period of the industry—perhaps from 30 years to 10 or 15 years. To expect the industry to come of age overnight, even with the help of millions from the Government, is not realistic.

Table 2. Present Titanium Prices

	Price per lb	Price per lb Ti content
Ilmenite concentrate (55% TiO_2)	$ 0.009	$ 0.027
Titanium slag (70% TiO_2)	0.018	0.043
Rutile concentrate (94% TiO_2)	0.06	0.106
Titanium tetrachloride, tech	0.40	1.58
Titanium oxide, pigment grade	0.24	0.40
Titanium sponge (A-1 grade)	4.50	4.50
Titanium metal: forging billet	9.00	9.00
mill plate	12.00	12.00
sheet (less extras)	15.00	15.00

Bases of Prediction

Up to this point I have tried to explain some of the problems which beset the titanium industry today. Skipping over the growth years, I offer my predictions, reasoned where possible, of what the matured titanium industry will look like.

Price of sponge, $1.15 per lb.

Price of ingot, $1.30 per lb.

Average price of mill products, $2.09 per lb.

Plant size of the order of 30,000 tons annual capacity.

Annual U.S. production, 200,000 tons or upwards.

Various assumptions are necessary in order to make clear the bases of my calculations and predictions.

1. Only processes for which commercial experience is available today will be considered as applicable to the mature titanium industry. This means that the Kroll process and consumable-arc, cold-mold melting will be chosen, for the purpose of prediction, as basic sponge and melting processes. This assumption will render my predictions conservative, since, as discussed, there are good reasons to believe that processes superior to the Kroll process will be developed.

2. The industry will be assumed to have reached a state of maturity in which the non-technological problems, discussed previously, have been eliminated or reduced to minor proportions. Only the passage of time can justify this assumption.

3. It will be assumed that the industry will have grown to such a size that individual integrated titanium plants of 20,000 to 40,000 annual-ton capacity may be justified. A plant of this size will permit economies in capital cost and labor, and economical recycling of by-products which cannot be achieved in smaller plants.

4. Cost estimates will be based on the average value of the dollar in the 1953-1954 period.

The cost and price predictions are, I believe, conservative. In particular, it is my hope that assumption No. 1 will prove false, and that consequently, titanium prices will be lower than those predicted. Aside from the uncertainty of this assumption, price predictions should be valid within an error of ± 25%. Even while admitting these uncertainties, the predictions are useful in guiding our present thinking on the problems of the titanium industry.

What Ores Will Be Used

Titanium, like aluminum and iron, is blessed with a relative abundance of raw materials. Titanium is the fourth most abundant structural metal in the earth's crust, exceeded only by aluminum, iron, and magnesium. Important ores of titanium can be grouped in the following three cate-

gories of increasing availability: rutile (TiO_2), which usually occurs in sand deposits; concentrateable ilmenite ($FeTiO_3$), which occurs in sand as well as in rock deposits; and non-concentrateable, ferruginous ilmenite (an extremely fine intergrowth of ilmenite with magnetite or hematite), which occurs in rock deposits.

North America has all three forms of titanium ores. Ilmenite, concentrates (44-to 60% TiO_2) are produced from deposits in New York, Idaho, Virginia, and Florida. The first of many known deposits of ferruginous ilmenite to be exploited on a commercial scale is a huge deposit at Allard Lake, Quebec. Rutile concentrates (95% TiO_2) are produced from beach sands in Florida, and a new important deposit has recently been found at Oaxaca, Mexico. Aubudance of titanium ores on this continent, and throughout most of the world, is one of the most significant signposts for the future importance of this metal. Unlike copper, nickel, and cobalt, scarcity of ores is not likely to limit the importance of titanium or to add appreciably to the cost of producing the metal.

Why Rutile Now

For several reasons rutile would seem to be the logical ore on which to base the production of titanium metal. Production of titanium by the Kroll process requires that titanium ores first be converted to titanium tetrachloride. Crude titanium tetrachloride ($TiCl_4$) is made by contacting a mixture of oxide titanium ore and carbon with chlorine at high temperature. Any iron present in the ore will also be converted to ferric chloride, which must subsequently be separated from the $TiCl_4$. The presence of iron in the ore increases the consumption of chlorine and complicates the separation of ferric chloride and $TiCl_4$. For this reason, the purest possible ore, rutile (about 94-96% TiO_2, plus iron oxide and other oxides), permits the simplest technology and lowest chlorine consumption for production of titanium tetrachloride.

Although today, rutile is the preferred raw material for titanium manufacture, two important factors make it doubtful that a greatly expanded industry could rely upon rutile as a raw material. These are the relatively high cost (10.6c per lb of contained Ti for rutile, against 2.7c per lb of contained Ti for ilmenite), and the relative scarcity of rutile compared with ilmenite. Despite a relatively eager market for titanium minerals in the pigment and welding-rod industries, the U.S. produced only 6,800 tons of rutile during 1954, as against 546,500 tons of ilmenite concentrates. Australia, relatively rich in rutile deposits, exported only 11,500 tons of rutile to the U.S. during 1954. It would require about 340,000 tons of rutile each year to feed a 200,000-ton titanium metal industry. This would mean a twenty-fold expansion of domestic rutile production and imports —an unlikely eventuality.

> "... Strong financial backing from the Government ... will certainly shorten the growth period of the industry — perhaps from 30 years to 10 or 15 years."

During its early growth period the titanium industry will rely heavily on rutile. But later, when production increases, and costs of a few cents a pound become more important, a shift to the more abundant, cheaper ilmenite will take place.

It is less clear whether high-grade ilmenite concentrates (46-60% TiO_2) or low-grade ferruginous ilmenite (15-35% TiO_2) will prove the preferred raw material for the titanium industry. Production of high-grade ilmenite concentrates is already a large (500,000 tons per year in the U.S.) and established enterprise. The current price of $16 to 20 per ton (2.7c per lb of contained Ti), which includes cost of mining and a moderately expensive series of ore-dressing operations, may be accepted as a stable price.

Slag-Smelting Ahead

Only one company, and that a youngster of four years, is mining and treating a low-grade ilmenite. This operation, which must be considered semi-experimental in nature, smelts a ferruginous ilmenite (35% TiO_2) to yield pig iron and a rich titanium slag (70% TiO_2). Current price of the slag is $36 per ton (4.3c per lb of contained Ti). Improved methods of slag-smelting have been demonstrated on a small scale, and slags containing 80% TiO_2, or better, can be produced.

When you consider that the expense of ore-dressing is cut drastically during the treating of ferruginous ilmenite, that pig iron is produced as a valuable by-product, and that the product is richer in TiO_2, it seems likely that slag-smelting of low-grade ilmenites will capture the raw material market for titanium metal. Since the slag-smelting industry is very new, I will assume, for the purpose of prediction, that maturity of the industry will produce an improved product at the same price—an 80% TiO_2 slag for $36 per ton (3.7c per lb of contained Ti). Although this price is still higher than for ilmenite concentrate (2.7c per lb of contained Ti), the far lower content of iron in the slag will make possible a cheaper production of $TiCl_4$.

Inherent Problems In Titanium Manufacture

From the beginning of sponge production to the final fabrication of a consumer product, the peculiar properties of titanium necessitate radically new methods of metallurgical processing. It will be helpful to briefly review these unusual properties before considering production processes.

If reactivity of metals is compared, using standard free energy of formation of the oxide (per mole of oxygen) as a yardstick, titanium appears as a moderately reactive metal. It is more reactive than iron, manganese, or zinc, but less than aluminum, magnesium, or sodium. What this yardstick omits from consideration, however, is the deeply disconcerting and almost unexampled ability of titanium to dissolve considerable percentages of oxygen in the solid as well as the liquid state. To further complicate the problem, titanium also dissolves nitrogen, carbon, and hydrogen, and forms an unusually stable carbide.

These four troublemakers—O, N, C and H, or the "interstitial alloying elements" as they are called—also cause titanium metal to lose its quality of ductility and toughness if they are present in more than minor quantities. Today's specifications for most titanium metal products call for less than 0.1% O, 0.06% C, 0.04% N, and 0.01% H. There is some indication that future specifications may require even less than 0.1% O, especially for applications where extreme toughness is necessary.

Behavior of the interstitial alloying elements has most profound implications for titanium metallurgy. Because titanium can dissolve oxygen, an infinitely strong reducing agent would be required to completely eliminate oxygen from the metal, if it were made directly from TiO_2. (By use of calcium metal, the strongest known chemical reducing agent, titanium containing 0.2% O can be made di-

rectly from TiO_2. Efforts to reduce the oxygen content further have so far proved unsuccessful.)

Whenever titanium is held at temperatures where reaction rates are high (above 700 deg C), such as during reduction in the Kroll process, or melting into ingot, it must not come into contact with any gas, liquid, or solid which contains C, O, N or H. Hot titanium will pick up oxygen from CO, CO_2, H_2O, and even from normally inert solids such as SiO_2, Al_2O_3, and MgO. This very property of titanium makes it valuable in laboratory work as a "getter" to remove the last traces of oxygen or nitrogen from the inert gases, but this is of small comfort to the metallurgist.

Normal oxide refractories cannot be used to hold molten titanium, and carbon is equally unsatisfactory because of the solubility of carbon in the metal. In fact, there is no refractory know—even in the laboratory—which is suitable to hold molten titanium without resulting in serious contamination. The only suitable container for liquid titanium is solid titanium, and on this subterfuge is based the present method for melting titanium, the cold-mold crucible.

These properties of titanium are scientific facts. No amount of research can be expected to markedly change the behavior of O,N,C and H towards titanium. Though there may be major technological improvements in the titanium industry of the future, these improvements must reflect the unchanging physical-chemical behavior of the interstitial elements. Titanium will always be produced and melted in a vacuum or inert-gas atmosphere. The only atmospheres inert to hot titanium will be the rare gases (He, A, etc.) and vapors of the alkali and alkaline-earth halides. It will always be necessary to prevent liquid titanium from contacting refractories. Preparation of the pure metal directly from the oxide will remain a next-to-impossible task.

Production metallurgy of titanium metal will always be of a special nature. It will always be necessary to take more precautions and to use more expensive processing techniques than are necessary for other metals such as aluminum, iron, and magnesium. As a consequence, it is safe to assume that titanium will always be more expensive than these metals.

How Sponge Will Be Produced

To estimate the cost of titanium sponge production we must consider both production costs and capital investment. Both of these estimates require that a definite flowsheet be used as the basis of the calculations. The flowsheet of the future integrated Kroll-type plant may be divided into the four basic parts discussed below.

> **"Where the combination of minimum weight and service in the temperature range of 300-800 deg F is required, titanium has no competition."**

1. Preparation of pure $TiCl_4$: This operation consists of the contacting of a mixture of titanium ore and carbon with chlorine in the temperature range 800-1000 deg C. No unusual precautions need attend the functioning of this reaction, which may be written as follows:

$$TiO_2\ (s) + 2C(s) + 2Cl_2\ (g) \rightarrow TiCl_4\ (g) + 2CO\ (g)$$

The reaction is slightly exothermic, so that once operating temperature has been reached, little or no additional fuel is required if the reactor is well insulated. The process is well adapted to continuous operation. It has been carried out successfully in a shaft furnace by use of briquettes of carbon and ore. Adaption of the fluid-bed technique of solid-gas contacting might offer advantages over the shaft furnace and it is rumored that one company has perfected such a process.

Vapors from the chlorinator contain $TiCl_4$, CO, CO_2, $FeCl_3$ and minor amounts of other impurities. These are condensed to eliminate the major portion of the non-condensable gases (CO, and CO_2). The condenser gases possess a high fuel value and can be used elsewhere in the plant for heating purposes. The condensed product is mainly liquid $TiCl_4$ and solid $FeCl_3$, which may be crudely separated by filtration or centrifugation, and finally by distillation of the $TiCl_4$.

At present no attempt is made to recover chlorine from the small amount of $FeCl_3$ derived from chlorinating of rutile. In the 30,000-ton plant of the future which will treat titanium slag, however, it will be economical to recover the chlorine consumed by the iron. Though technology of this recovery is not well developed at present, there is no reason to expect that it will offer insurmountable difficulties.

Crude $TiCl_4$ must be very carefully purified to free it from the last traces of oxygen, nitrogen and numerous other minor impurities. This is accomplished by continuous fractional distillation coupled with chemical treatment for precipitation of certain trace impurities.

The complete flowsheet of the chlorination plant consists, then, of preparation of chlorinator feed, chlorination, condensation, separation of $FeCl_3$ sludge, recovery of chlorine from the sludge, and purification of the $TiCl_4$. All these processes can be accomplished in continuous reactors with automatic control and a minimum of labor. Such chlorinating plants, with the exception of the chlorine recovery step, are being built and operated today. There is no need of assuming a considerable advancement in technology here. Present costs for chlorinating plants are $650-700 per annual ton of titanium metal capacity. In the far larger plant of the future it is safe to assume that this cost can be reduced to $600 per annual ton of titanium capacity, even though the process for recovery of chlorine from iron chloride is added to the flowsheet.

Kroll Process Confusion

Perhaps no other aspect of cost in the Kroll process has been so misunderstood as that for production of $TiCl_4$. Present market price of $TiCl_4$ is $0.40 per lb. Since it requires about four pounds of $TiCl_4$ to produce a pound of titanium metal, it has been assumed, without justification, that the Kroll process contains an inherent raw material cost of $1.60 for $TiCl_4$ alone. The present price of $TiCl_4$, however, reflects the high costs of a material with a small and uncertain market. Even today, operators of titanium metal plants are mentioning prices of less than 10c per pound for $TiCl_4$ made on a large-scale by continuous processes. In the analysis which follows, production of TiCl4 is considered as an integral part of sponge production and no separate selling price for $TiCl_4$ is estimated. However, it will be evident from the cost data that $TiCl_4$ preparation represents less than 25% of the total cost of sponge manufacture.

2. Reduction of $TiCl_4$ by magnesium: This step is the heart of the Kroll process. Liquid $TiCl_4$ is run slowly into a tightly sealed reaction vessel which contains liquid magnesium metal and a positive pressure of pure argon gas. The reaction:

$$TiCl_4\ (g) + 2Mg\ (1) \rightarrow Ti\ (s) + 2MgCl_2\ (1)$$

is strongly exothermic. In order to

Table 3. Investment Cost for Sponge Production*

	Cost per Annual Ton of Ti	Total Cost
Chlorination plant	$ 600	$ 17,000,000
Sponge reduction and leaching	1600	48,000,000
Magnesium electrolysis	1000	30,000,000
Non-process (site, labs, administration, etc.)	300	9,000,000
Totals	$3500	$104,000,000

*Basis: 30,000 annual tons titanium sponge capacity. Includes all facilities for chlorination of titanium slag, reduction of $TiCl_4$ to metal, sponge purification by leaching and recycling of magnesium chloride by electrolysis. Make-up magnesium and chlorine to be purchased.

prevent excessive temperature in the reactor (900 deg C is the usual limit) $TiCl_4$ must be added slowly to allow time for heat to dissipate. Titanium forms as a sponge-like mass, and the liquid magnesium chloride is drawn off periodically. When the reaction is completed the vessel must be cooled to room temperature before it is opened and the contents removed. Removal of sponge from the reactor is in itself a difficult and costly operation. In some plants it is chiseled out with air-hammers; in others, the reactor is placed on a gigantic lathe and bored out. Still other plants probably have discovered how to prevent sticking of the sponge to the reactor walls, so that it may be dumped out in one large piece.

This reduction step is a batch process as practiced today. It is likely to remain a batch process unless the reaction is carried out under vastly different conditions than those now existent—in which case it would no longer be the "Kroll' process. However, batch processes are not per se unsatisfactory and costly. About 100-million tons of steel are made annually by a batch process—the open hearth process. As the batch is increased in size, and labor required for charging and discharging is reduced to a minimum, batch processes become more attractive.

Much has and can be done to improve the batch Kroll process. A method of preventing adherence of sponge to the reactor walls has already been mentioned. A method of accelerating heat removal would considerably shorten the time required for a single batch. Improved means of sealing the top of the vessel would eliminate much labor now required to tighten bolts. The size of a single Kroll batch has already grown to 3,000 lb of titanium in one plant, with an attendent reduction in labor and capital costs per ton of product. It is unlikely that much larger batches will prove practical.

Weak Point

It is this stage in titanium manufacture which is likely to remain relatively expensive—not because of the cost of power or raw materials, but because of large labor, maintenance, and capital costs. A new process for sponge manufacture must prove its worth by showing a saving over the Kroll process in labor, maintenance, and capital costs. This is often overlooked by eager partisans of new processes. As will be shown, raw material and power cost for a large, integrated Kroll plant may be as low as 30c per pound of titanium produced. Very few of the proposed new processes can better this.

3. Purification of raw sponge: Sponge taken from a Kroll reactor contains much entrapped magnesium chloride and a small amount of unreacted magnesium metal. There are two processes in use today for removal of these impurities. Most widely accepted is that of heating sponge in vacuum retorts at about 900 deg C. so that impurities can be distilled out. The other method is leaching the sponge with slightly acidified water to dissolve the magnesium chloride and to convert magnesium to magnesium chloride.

Obviously, the leaching method requires less expensive equipment and is more susceptible to semi-continuous operation and reduced handling costs. Until recently the leaching method has been in disrepute because titanium sponge is known to pick up as much as 0.05% hydrogen during the process, an amount sufficient to render the metal unfit for many purposes. In 1954, however, a new method was announced of melting titanium sponge into ingots under vacuum, which very effectively reduces hydrogen content of the sponge to a safe level. Thus, the combination of sponge purification by leaching followed by vacuum melting of the sponge to ingot is adequate protection against the contamination by hydrogen.

> ". . . It will be evident from the cost data that $TiCl_4$ preparation represents less than 25% of the total cost of sponge manufacture."

There is some possibility that the leaching method also introduces a small amount of oxygen into the titanium, and this impurity cannot be removed by vacuum melting. It appears from limited evidence, however, that the amount of oxygen so introduced is not sufficient to constitute a major liability. Unless developments in the physical metallurgy of titanium necessitate radically tightened specifications on the oxygen content, I believe that the leaching method of purification will be preferred by the future titanium industry because of lower costs involved.

Kroll Plant Cost

Cost of a moderate-size Kroll plant (including sponge reduction and purification by vacuum distillation, but excluding the chlorination plant and magnesium electrolysis) is about $2,000-2,500 per annual ton of capacity. Since the future plant, on which my predictions are based, is assumed to use essentially the same process, no major reduction in the cost can be assumed. However, increased size and substitution of leaching for vacuum distillation should both effect some economy. It will be assumed that capital investment for these two steps, sponge reduction and purification by leaching, will cost about $1,600 per annual ton of capacity.

4. Electrolysis of magnesium chloride: Every pound of titanium made by the Kroll process requires the use of about one pound of magnesium metal and three pounds of chlorine in the form of $TiCl_4$. Approximately four pounds of magnesium chloride are produced for each pound of titanium. About 75% of this magnesium chloride is tapped from the Kroll reactor as a pure, anhydrous liquid—ideal feed material for reconversion into magnesium metal and chlorine by electrolysis.

In a large plant this reconversion can be accomplished for less than one-half the cost of purchasing an equivalent amount of magnesium and chlo-

rine. Since advantage can be taken of the sensible heat and anhydrous nature of the magnesium chloride from the Kroll reactor, magnesium electrolysis should be physically integrated with the titanium plant. No large titanium plant of the future, using the Kroll process, will be without this recycle feature. Even today one of the moderate-size plants incorporates magnesium electrolysis in its flowsheet.

Technology of magnesium electrolysis is well developed today. Plant costs for conversion of anhydrous magnesium chloride to magnesium and chlorine, are about $1,200 per annual ton of magnesium. Since less than one pound of magnesium can be recovered for each pound of titanium produced, plant cost of magnesium electrolysis, per annual ton of titanium capacity, is about $1,000.

Estimated plant costs for a 30,000-ton integrated Kroll plant are summarized in Table 3. Total investment required is $104-million.

What It Will Cost to Produce Sponge

Table 4 gives an estimate of production costs for the future sponge plant. Costs are based on the assumption of somewhat better metallurgical performance, improved automatic controls, and lower maintenance costs than now prevail. Much of the analysis behind the estimates summarized in Table 4 is too detailed for presentation here but several important estimates deserve some further mention.

Table 4. Summary of Sponge Production Costs*

	Cost /lb	lb /lb of Ti	Cost per Year	Cents per lb Ti
RAW MATERIALS				
Slag (80% TiO_2)	$ .018	2.4	$ 2,590,000	4.3
Chlorine	.03	1.0	1,800,000	3.0
Magnesium	.30	0.3	5,400,000	9.0
Carbon	.01	0.8	480,000	0.8
Argon, leaching agents, etc.			900,000	1.5
Total for raw materials			$11,170,000	18.6¢
UTILITIES				
Electricity (14 kw-hr /lb of Ti at 7 mils per kw-hr)			5,880,000	9.8
Fuel			300,000	0.5
Water			600,000	1.0
Total for utilities			$ 6,780,000	11.3¢
PROCESSING COSTS				
Labor and supervision (1000 man-days /day at $20 per man-day including benefits)			$ 7,300,000	12.2
Maintenance and supplies (10% of process investment per year)			9,500,000	15.8
Total for processing			$16,800,000	28.0¢
NON-PROCESSING COSTS				
Insurance (1% of investment cost)			1,040,000	1.7
Research and testing			1,320,000	2.2
Administration and office (10% of processing cost)			1,680,000	2.8
Depreciation (5% of process investment)			4,750,000	7.9
Total for non-processing costs			$8,790,000	14.6¢
Grand total of production costs			$43,540,000	72.6¢

*Basis: 30,000-ton capacity (same as for Table 3)

1. Recovery of sponge equal to 87% of the titanium charged as slag, is estimated. Losses of titanium occur in chlorination residue and process loss during sponge reduction and leaching. A circulating load of clean-up residues, off-grade sponge fines, etc., amounting to 5% of the titanium entering the plant, is assumed. This has the net effect that all processes are assumed to consume reagents and power sufficient to produce 1.05 lb of titanium, whereas only 1.0 lb of finished product is produced.

2. Chlorine loss of 1.0 lb per pound of titanium produced is assumed. Principal losses are incomplete recovery from iron chloride, and magnesium chloride lost during leaching of titanium sponge. Make-up chlorine will be purchased at market price.

3. Loss of magnesium is assumed to be 0.30 lb per pound of titanium. Part of this loss occurs during leaching of crude sponge, part during magnesium electrolysis. Make-up magnesium will be purchased at market price.

4. Total power requirements are estimated at 14 kw-hr per lb of titanium. Much of this power is required for electrolysis of magnesium chloride (8-10 kw-hr per lb of Mg). The remainder is consumed in electric furnaces to heat reduction reactors to operating temperature, and other miscellaneous uses throughout the plant. A unit power cost of 7.0 mils per kw-hr is assumed.

5. Labor requirement is largest in the sponge-reduction plant. Individual reactors capable of producing one ton per day of sponge may require an average of two operators. About 85 such individual reactors are needed for a 30,000-ton plant, so that the labor force for sponge reduction is estimated at 255 men per shift or 765 man-days per three-shift day. An additional 235 man-days is assumed to be sufficient for operation of the chlorination, leaching and electrolysis plants. An average cost of $20 per man-day, including benefits, is assumed. Calculations are based on 3-shift operation.

6. Maintenance is the most costly single item in titanium manufacture. For the purpose of this estimate, maintenance has been assumed to cost 10% of the total process investment (10% of $95 million) each year. This item adds 15.8c cost to each pound of titanium produced—almost as much as the total for raw materials (18.6c).

7. No sales cost is added to the calculation because it is assumed that the sponge plant will be integrated with a melting and fabricating plant. The saleable product will be mill shapes rather than sponge, and a sales cost will be considered when the cost of melting and fabricating is considered.

Table 4 shows a total production cost for titanium sponge of 72.6c per lb. This includes tax-deductable items of overhead cost, but does not provide for earnings or income taxes. To justify the investment of $104 million, the market price of titanium sponge

Table 5. Effect of Sponge Price on Earnings*

	Sponge Price, Dollars per lb		
	1.10	1.15	1.20
Net sales	$66,000,000	$69,000,000	$72,000,000
Cost of production	44,140,000	44,140,000	44,140,000
Income before taxes	21,860,000	24,860,000	27,860,000
U.S. income taxes (52%)	11,360,000	12,930,000	14,500,000
Net income	$10,500,000	$11,930,000	$13,360,000
Years to amortize investment	10.0	8.8	7.9

*Basis: 30,000-ton plant as described in Table 2

must be sufficiently larger than production cost for the earnings of the company to repay the capital in a reasonable time.

Financing of an investment of this type would most likely come from the accumulated capital of a large mining and metallurgical company. Providing the titanium industry is relatively stable, which is a basic assumption underlying these estimates, the company might expect the earnings of the sponge plant to repay the capital in about 10 yr time. In Table 5, earnings of this hypothetical investment are analyzed as a function of the market price of titanium sponge. This analysis shows that a market price of $1.15 per lb of sponge would permit repayment of the capital in 8.8 yr from start of production. Since construction of the plant will require about two years, the capital must be paid out, on the average of a year in advance of the start of production. Hence I conclude that a market price of $1.15 per lb of sponge would be sufficient inducement for the expenditure of the necessary capital. This value will be the assumed market price for sponge throughout the remainder of the calculations.

Production of Titanium Ingots

It is expedient to analyze separately the costs of ingot production (melting) and mill-product fabrication. This separate analysis does not imply that separate companies may undertake these operations in the future. Undoubtedly, melting and fabrication of titanium will be integrated in one plant. In fact, it is likely that the entire spectrum of the titanium industry, from mining to fabrication, will be integrated by several large companies. Separate cost accounting shown here is necessary to establish an estimated market price for ingot titanium, from which mill product prices may, in turn, be estimated.

Most satisfactory method for melting titanium known today—hence, by assumption, the method to be considered for the hypothetical plant of the future—goes by the name of cold-mold, consumable-arc melting. Here is the essence of the process:

1. Sponge and scrap to be melted are pressed into a rectangular electrode section. Electrode sections are then welded together to form one large electrode of suitable size.

2. A small amount of sponge in the bottom of a cylindrical water-cooled, copper crucible acts as the other electrode of a dc arc. The entire furnace is tightly sealed to prevent contamination by air or other gases. A stream of argon is passed through the furnace to sweep out vapors and prevent influx of air, or else the furnace is maintained under vacuum. When the arc is struck, the consumable electrode slowly melts to form a pool of liquid metal. The water-cooled crucible causes a layer of solid titanium to form instantly on the walls of the crucible, so that the pool of liquid titanium is effectively held in a "skull" of solid titanium.

3. Since only a small portion of the total ingot made by cold-mold melting is liquid at any one time, distribution of impurities and alloying elements is non-homogeneous. To minimize effect of inhomogeneity, it has become common practice to "double melt" titanium ingots. Small ingots (1000 lb) are melted in the first step, after which several of the small ingots are welded together to form the consumable electrode for the "second" melt. "Second" melt ingots weigh 2000-3000 lb.

> "Titanium will always be produced and melted in a vacuum or inert gas atmosphere . . . Preparation of pure metal directly from the oxide will remain a next to impossible task."

Surfaces of ingots made by cold-mold melting usually contain pits, cavities, and pieces of incompletely-melted sponge. For this reason most plants have to turn off the outer surface of the ingot in a lathe prior to forging and rolling. This practice produces 5 to 10% scrap metal, most of which can be remelted in a subsequent batch.

After removal of the outer surface, the ingot may then be crudely forged into a "break-down." The "break-down" will require "conditioning" to grind off surface imperfections before its fabrication into mill products. It is at this stage—production of "conditioned break-downs," or conditioned ingots, as they will hereafter be called—that the differentiation between melting costs and fabrication costs will be made.

Flowsheet for Melting and Fabrication: A quantitative flowsheet for the production of titanium mill products from sponge and scrap is given on page 81. Bases for estimation of tonnages are as follows:

1. The plant is assumed to use 30,000 tons of sponge per year. Most of the important alloys of titanium contain a total of about 8% of alloying elements. Therefore, 2,600 tons of alloying elements must be added to 30,000 tons of sponge.

2. Unrecoverable loss of titanium during processing is estimated at 10% of the metal added to the circuit. About ⅛ of this loss occurs during ingot conditioning, and ⅞ during fabrication.

3. Single-pass recovery of mill products from the crude ignot (before recycle of home scrap) is assumed to be 65% on the average. A value of 70% is more appropriate for production of forging billet and bar stock, while 55% would apply to sheet products.

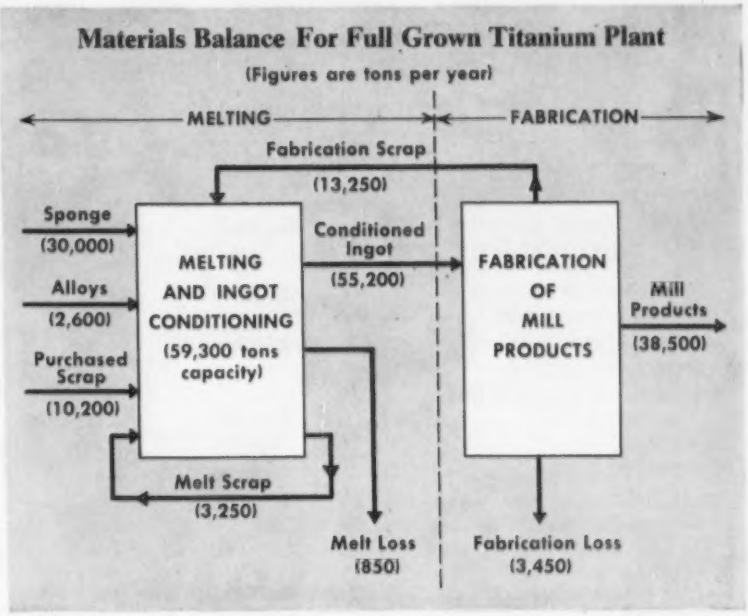
4. Estimated generation of remelt scrap from the surface conditioning of the ingot is 5.5% of the crude ingot.

5. Amount of purchased consumer-scrap is calculated as that necessary to bring the scrap charge in melting to a total of 45%.

Kinds of scrap: The melting plant

of the future will be equipped not only to remelt "home scrap" (scrap resulting from mill-product fabrication) but also, purchased or consumer scrap (scrap generated by the consuming industry). At this point I must distinguish between two grades of titanium scrap according to purity. Re-melt scrap (no matter what the origin) must be clean, uncontaminated, and segregated according to alloys. No means has yet been devised to remove impurities such as oxygen, nitrogen and carbon during the melting process.

Therefore, it is essential that remelt scrap approximate titanium sponge with respect to the impurities O, N, and C, and that the alloying elements in remelt scrap approximate those in the alloy to be produced. This makes extreme care necessary in scrap segregation and cleaning—care which is not necessary for scrap of many other metals. All scrap considered in the flowsheet is remelt scrap.



Titanium Wastes

The second classification of titanium scrap might well be called "titanium wastes." This is material which has become heavily contaminated with O, N or C, or which consists of unsegregated alloys. Titanium wastes will require a refining process to reconvert them to pure metal. No such process has yet been developed on a commercial scale, but several promising processes are near the pilot-plant stage. When a refining process is perfected, titanium wastes will be recovered, but the market price of these wastes will always be far lower than that for remelt-scrap. No consideration is given to titanium waste recovery in the flow-sheet used here.

Value of titanium scrap (remelt grade) bears an important relation to calculation of the cost of producing titanium ingot and mill products. I have attempted to estimate this value by comparison with the scrap value of other similar metals. The market price of stainless steel scrap varies from 15 to 33% of the price of ingot. Aluminum scrap prices are 69 to 75% of the price of ingot. Nickel scrap prices vary from 51 to 77% of the price of pure nickel.

Since by definition titanium remelt-scrap requires that it be almost the equivalent of sponge in purity, it seems logical that the market price will be a large percentage of the price of sponge. However, two factors argue for at least a moderate spread in price between scrap and sponge titanium. Remelt scrap will always be somewhat less pure than sponge, and the use of scrap in consumable-electrode melting will involve greater difficulty and expense than the use of sponge. The balance of these factors, in my opinion, suggests an eventual market price for remelt scrap of 80c per lb—70% of the price of titanium sponge.

Titanium melters are today using up to 30% of remelt scrap in their melting charges. This is almost wholly "home" scrap, but the use of consumer scrap will follow before long. The hypothetical melting plant here considered, is assumed to melt a charge consisting on the average of 45% scrap — 27.8% of which is "home" scrap and 17.2% consumer scrap.

What Titanium Ingots Will Cost

To estimate the market price of conditioned titanium ingots, the flowsheet of the future plant (above) was divided into two parts as indicated by the dotted line. Cost and price estimates shown in Table 6 and 7 apply only to that portion of the flowsheet to the left of the dotted line. Processes under consideration are: sponge and scrap handling, pressing of consumable electrodes, melting of ingot, removal of the ingot surface, ingot break-down, and grinding of the break-down surface.

Investment cost for these operations is estimated as $1,000 per annual ton of conditioned ingot, or $55,000,000 for a plant to produce 55,000 tons of conditioned ingot per year. There is little data available to substantiate this cost estimate. Compared with the cost of melting plants for other metals, the figure is very high. However, remember that the method of melting titanium is very unusual and consists of a small batch process.

Table 6 shows an analysis of the production costs for titanium ingot. Several items in this analysis require comment.

Since production costs and market price of conditioned ingot are analyzed separately from mill-product fabrication, "home" scrap generated during fabrication (13,350 tons) is charged as a raw material cost to ingot production.

The plant is assumed to have 54 "first melt" furnaces, each producing two one-half ton ingots per shift, and 36 "second melt" furnaces, each producing one ingot of 3,000 lb per shift. Each furnace is assumed to require an average of one operator per shift. Three-shift operation is employed. Furnace operators account for a little over half of the total labor force.

Earnings from ingot production are analyzed in Table 7, as a function of market price of conditioned titanium ingots. From this it is estimated that a price of $1.30 per lb would produce sufficient earnings to justify the investment.

What Mill Products Will Cost

To attempt a detailed estimate of the cost of fabricating mill products

Table 6. Production Costs for Melting and Ingot Conditioning*

	Yearly Cost	Cents per lb of Conditioned Ingot
RAW MATERIALS		
Titanium sponge; 30,000 tons at $1.15 /lb. .	$ 69,000,000	62.5
Tit. scrap, purchased; 10,300 tons at 80¢ /lb.	16,320,000	14.78
Tit. scrap ("home") from fabricating: 13,250 tons at 80¢ /lb	21,200,000	19.20
Alloying elements: 2,600 tons at $1.00 /lb. .	5,200,000	4.7
Total for raw materials	$111,720,000	101.20¢
UTILITIES		
Electricity (2.2 kw /hr /lb ingot at 7 mils /kw hr)	1,820,000	1.65
Water and fuel	500,000	.45
Total for utilities	$ 2,320,000	2.10¢
PROCESSING		
Labor and supervision (500 man-days /day at $20 /man-day)	3,650,000	3.31
Maintenance and supplies (10% of investment)	5,500,000	4.98
Total for processing	$ 9,150,000	8.29 ¢
NON-PROCESSING		
Insurance (1% of investment)	550,000	.50
Research and testing	500,000	.45
Administration and office (10% of processing)	910,000	.83
Depreciation (5% of process investment). .	2,750,000	2.49
Total for non-processing	$ 4,710,000	4.27¢
Grand total of production costs	$127,900,000	115.90¢

*Basis: Plant is designed for melting 30,000 tons per year of sponge plus "home" scrap and purchased scrap to give a total melting capacity of 60,000 tons per year. See Fig. 1 for a quantitative flowsheet. Production of conditioned ingot is 55,200 tons per year.

The costs given below include only sponge blending, scrap handling, pressing of electrodes, double melting of ingots, ingot break-down, and ingot conditioning. The estimated capital cost for these operations is $55,000,000.

from titanium ingots is beyond my capabilities. However, there are several known factors which, if given sufficient consideration, make possible rough estimates of the market prices to be expected for titanium products.

Fabrication of titanium is similar in nature to that of stainless steel. Indeed, titanium is fabricated in stainless steel facilities today. Most mill men agree that titanium is no more difficult to hot form (hot rolling and forging) than stainless steel. Cold rolling and cutting of titanium do require about three times as long as the equivalent operations on stainless steel. Grinding of titanium and stainless steel are of about equal difficulty. The yield of mill products from conditioned titanium ingots should be about the same as for stainless steel when the industry has matured. However, because the ingot price of titanium is estimated to be about six times the price of stainless steel ingot, cost of fabrication losses and recycling of fabrication scrap may be six times for titanium what it is for stainless steel.

A further consideration affecting the cost of fabricating, stems from the density difference of stainless steel and titanium. Titanium has about 57% the density of stainless steel. Therefore, a titanium plant of equal volume capacity with a steel plant will have only 57% of the weight capacity of the steel plant.

Table 7. Effect of Ingot Price on Earnings

	Ingot Price, Dollars per lb			
	1.20	1.25	1.30	1.35
Net sales	$132,500,000	$138,000,000	$143,500,000	$149,000,000
Cost of production	127,900,000	127,900,000	127,900,000	127,900,000
Income before taxes	4,600,000	10,100,000	15,600,000	21,100,000
U.S. income tax (52%)	2,390,000	5,250,000	8,110,000	10,970,000
Net income	$2,210,000	$4,850,000	$7,490,000	$10,130,000
Years to amortize investment	24.9	11.3	7.3	5.4

Fabricating Costs

In my opinion, these factors add up to a cost of fabricating titanium of about four times the cost for fabricating stainless steel on a weight basis. From this estimate, market prices of titanium mill products may be derived.

Market prices of 302B stainless steel (a typical heat-resistant 18-8 steel) are: 19c for ingot, 31c for forging billets, 38c for plates and 45c for sheets or cold-rolled strip. Price differentials between ingots and the three forms of mill products, are 12c, 19c, and 26c, respectively.

These price differentials reflect the cost of manufacture plus the earnings for the process. For titanium, these same price differentials might be multiplied by four to yield the mark-up in price from titanium ingot to yield the price of mill products. Results given in Table 8, show an average price of $2.09 per pound for mill products.

I have tried a number of other schemes to estimate prices of titanium mill products. These have made allowances for production of scrap and losses during fabrication, the effect of the ingot price on product price, and a number of other variables. Results all point to mill product prices between $1.75 and $2.75 per lb if titanium ingot is $1.30.

Prices of titanium ingot and mill products were analyzed separately for convenience. A check on the validity of the estimates can now be made by considering the entire flowsheet on p 81 as a unit.

If $2.09 per lb is accepted as the average price of titanium mill products, gross sales value of mill products from an integrated plant incorporating the flowsheet on p 81 would be $161,000,000 per yr. Costs of ingot

production for the same plant are (Table 6) $127,900,000, less a credit of $21,200,000 for "home" scrap which was charged to the melting plant. There remains, therefore, $54,300,000 to cover the cost of fabrication (utilities, processing and non-processing costs) and gross earnings of the integrated plant. Even if the cost of fabrication was $25,000,000 per yr, there would remain sufficient net earnings to justify a total plant cost of $140,000,0000 ($55,000,000 for melting, $85,000,000 for fabrication).

Table 8. Estimated Future Market Prices for Mill Products, Dollars per lb.

	Price of Ingot Ti	Ingot–Mill Product Price Differential	Product Price
Forging billet....	$ 1.30	4** x $ .12*	$ 1.78
Plates.....	1.30	4** x .19*	2.06
Sheets	1.30	4** x .26*	2.34
		Average...	$ 2.09

*Differential for stainless steel.

**Factor of relative difficulty in fabricating between titanium and stainless steel.

Significance of Price Estimates

Price estimates have been made for the mature titanium industry. This is how these estimated prices compare with current prices:

Table 9. Titanium Prices

(per pound)

	Current Price	Price at Maturity
Slag (70% TiO_2).....	$ 0.018	—
Slag (80% TiO_2).....	—	$0.018
Sponge.....	4.50	1.15
Ingot (conditioned)...	—	1.30
Forging billet.....	9.00	1.78
Plates.....	12.00	2.06
Sheets (less extras)...	15.00	2.34

Should the reader conclude that, even at maturity, titanium will be a relatively high-price product, I wish to add two modifying thoughts to his conclusion.

In the first place, I firmly believe that the *inherent* difficulties of titanium manufacture, which stem from the unalterable physical - chemical properties of the metal, will result in prices several times in excess of the prices of aluminum and stainless steel. No matter how ingenious a new process for titanium manufacture may be, this conclusion should be valid. The very need of ingenuity in titanium manufacture points out the existence of difficulties to be overcome. Overcoming difficulties is expensive. I cannot conceive of titanium prices which are less than twice of those of stainless steel.

Secondly, I wish to emphasize strongly that the projected prices shown are based on an eventuality that is, by all odds, unlikely—that no major improvement in titanium technology will be made. I have shown that a substantial reduction in price of titanium is possible even if no major improvement in processes is made. However, I would be most surprised and disappointed if the future of the titanium industry followed the course of my predictions. It is far more likely that, before the industry is mature, new processes will be introduced that will prove more economical than those used as the basis of my calculations. In this event the prices of titanium products in the mature industry may be one-half of those shown in Table 9.

The value of the estimates I have made lies in their pointing out reasons for the relatively high price of titanium. By thus projecting the present state of titanium technology to a mature future, the temporary problems of the infant industry have been swept aside, and the shortcomings of the basic technology exposed. Raw materials and power account for but one-fourth of the projected price of titanium sponge. The remaining three-fourths of the sponge price stems from three major shortcomings of the Kroll process; capital-cost, labor and maintenance. The same shortcomings are characteristic of cold-mold melting.

Proposed new processes for titanium manufacture have to be compared with the Kroll process on the basis of capital-cost, labor, and maintenance. It is unfortunate that these are the very costs that cannot be estimated with accuracy unless the process has been studied exhaustively on a pilot-plant scale. It is this factor which justifies the Government policy of sharing the cost of pilot-plant studies of new titanium processes.

No Big Profits Now

Another erroneous conclusion that might be drawn from predictions summarized in Table 9 is that present producers of titanium sponge and mill products must be making fabulous profits at the expense of the Government. Nothing could be further from the truth. Difficulties that now confront the industry were considered earlier (p 74). These difficulties add up to a constant effort to operate in the black even at today's high prices. Our Government is fortunate that companies now in the titanium business are sufficiently far-sighted to accept their present problems in hope of an improved future.

What Titanium Will Be Used For

In previous sections it was assumed that titanium possesses properties of such unusual value that a large demand is inevitable. Here I will examine its usefulness and predict the possible extent of the market when prices have reached predicted levels.

Outstanding properties of titanium are briefly reviewed in Table 1. These properties lead naturally to structural uses for titanium. The greatest advantages will be gained from the use of titanium by application to structures where minimum weight, corrosion resistance, or use at elevated temperature is required.

1. Structures requiring minimum weight. When minimum weight is required in the stressed part of a structure, strength-to-weight-ratio (SWR) of the material is a measure of the material's effectiveness for this purpose. The high strength of titanium alloys and moderate weight, mean a high SWR. Aluminum, though lighter, has a relatively low strength, hence a moderate value of SWR. Steels, though strong are also heavy, hence possess a moderate value of SWR. High - strength titanium alloys are superior in SWR to all steels except for a few super strength steels of limited application.

Factors other than SWR must be considered in the design of stressed members, such as buckling, modulus of elasticity and fatigue strength. It would be unrealistic to conclude that in all cases titanium permits the de-

Dedication

This article is dedicated to those men in research laboratories, industry, the armed services and various government agencies whose foresight, hard work and belief in this new metal are responsible for the advances that have been made in titanium technology. The outlook for the future justifies the attention they have lavished on titanium. Individual acknowledgements of my sources of information would necessitate my naming everyone that I have talked with about titanium since early 1954, and others, as well. To them all, I gratefully acknowledge my indebtedness, but reserve for myself the responsibility for errors in my predictions.

H. H. Kellogg

sign of lighter structures than aluminum or steel. Nevertheless, the SWR does illustrate potential usefulness of titanium for light structures.

We should now ask: In what structures will reduction in weight be sufficiently valuable to justify the extra cost of titanium. The answer is: In structures which must move! That is, in transportation facilities (air, land, and sea), moving parts of stationary machines, and equipment which must be moved, either by hand or by vehicle.

Of these uses, the one which gains the greatest advantage from reduction in weight is aircraft. Evidently, advantages here are sufficient to justify limited use of titanium, even at today's prices. As the price drops we can expect titanium to provide more uses in hand-borne and air-borne military equipment, in critical parts of trucks, tractors, railroad equipment, and possibly in automobiles.

2. Corrosion Resistance. Corrosion of metallic equipment exacts a huge price from our modern industrial civilization, for maintenance and replacement of corroded objects. It is easy to understand the overall economy of spending more money for a corrosion resistant item, if maintenance and replacement costs can be reduced thereby.

Aluminum, stainless steel, copper and brass all possess resistance to certain types of corrosion. Where these relatively inexpensive metals are equal to the service to which they are applied, more costly titanium cannot expect to compete. However, there remain numerous uses in industry, and in marine service for tanks, valves, pipes and fittings where a material of superior corrosion resistance would justify the extra cost. Titanium can expect to find important applications for this purpose.

3. Elevated Temperature Use. Many metals cannot be used at high temperatures, either because they (copper, mild steel) are attacked by corrosive atmospheres, or because they (aluminum, magnesium) lose their strength. The industrial trend is toward more high temperature processes, to improve fuel economy in power generation, for atomic power generation, and to improve processing results in a variety of industries. The search for materials of construction to withstand high temperatures is constantly going forward.

Limited But Important

Titanium will occupy a limited, but important place among construction materials for high temperature use. Titanium is limited to uses below 800 deg F (this may possibly be raised to 1000 deg F by development of new alloys, but probably not beyond this temperature). However, below this temperature it offers many advantages over other metals—particularly, its high SWR. Where the combination of minimum weight and service in the temperature range of 300 to 800 deg F is required, titanium has no competitors. This is the service for which most of the titanium is now being employed in jet engines and aircraft applications. Future uses of this kind may include high-pressure boiler tubing, use in atomic power generation, and high temperature processing in the chemical industry.

> "I cannot conceive of titanium prices which are less than twice those of stainless steel."

How Much Titanium Will Be Used?

When titanium prices reach those estimated in Table 9, I predict that production and consumption of titanium in the U.S. will be about 200,000 tons per year. When new processes make it possible to reduce these prices by half, a consumption of 400,000 tons per year seems likely.

I am sure the reader will realize that these predictions are but reasoned guesses—not estimates. The bases of my guesses are a follows:

1. Peacetime utilization of titanium is assumed. Maintenance of powerful Armed Forces is assumed, but rapid build-up of these, or heavy stockpiling by the Government is excluded.

2. Sales value of titanium is assumed to be equal to the average of the present sales value of the aluminum and stainless steel industries. It is well known that, other factors being equal, consumption of competitive metals is, roughly, inversely proportional to price. On this basis, comparison of the present consumption and prices of aluminum and stainless steel with the estimated prices of titanium indicate a consumption of about 200,000 tons of titanium for the mature industry.

Factors which might result in an even higher rate of consumption are the special importance which titanium will have for military preparedness (where cost is a secondary concern), increasing importance of materials for high-temperature use, and increasing level of consumption of all metals by our industrial civilization.

Conclusion

Titanium can be produced by presently-known technology at much lower prices when the industry reaches maturity. Development of improved processes will make even lower prices possible. Titanium will, however, never be as cheap as aluminum or stainless steel. For this reason its uses will be limited to those where weight saving, heat resistance, or corrosion resistance justify the extra cost of titanium. A consumption of several hundred thousand tons annually is forecast for the mature titanium industry.

Who's Doing What in Titanium Production Today

WHILE THERE ARE NOW only two commercial producers of titanium metal, three other companies are building plants, and a number are in negotiating or research stages of development. Here is a brief run down of who is doing what today.

Anaconda Copper Mining Co. Engaged in research.

Bohn Aluminum and Brass Corp. Cooperating with Glidden Co. in research.

Cramet, Inc. This subsidiary of Crane Co. is building a 6,000-ton per year plant near Chattanooga, Tenn. Some units are already in operation but capacity probably will not be reached until early in 1956. Now treating Australian rutile in a modified Kroll process but shortly should be switching to ore from its own Florida and North Carolina mines.

Dow Chemical Co. Developing a modified Kroll process in its 600-lb per day pilot plant at Midland Mich. On the basis of a Government agreement, Dow will put an 1,800-ton per year plant in operation next year. A distinct advantage is the company's important position in both magnesium and chlorine production.

E. I. du Pont de Nemours & Co. This titanium pioneer is producing 10 tons a day at its Newport, Del., plant and is negotiating with GSA to build a 7,500-ton per year plant at Waverly, Tenn. Du Pont is using a modified Kroll process but spending a considerable amount of money investigating other methods. Owns ilmenite deposits at Trail Ridge, Fla., and is presently interested only in sponge manufacture.

Eagle-Picher Co. Engaged in research.

Glidden Co. Cooperating with Bohn Aluminum in research.

Harvey Machine Co. Seeking a GSA contract that would mean a 6,000-ton per year plant.

Horizons Titanium Corp. Plans to pilot an electrolytic process at Stamford, Conn.

Kaiser Aluminum & Chemical Corp. Engaged in research.

Kennecott Copper Corp. Two thirds owner of Quebec Iron & Titanium Co., which owns huge ilmenite deposit (over 100 million tons) in Quebec, and operates smelter at Sorel, Que., producing a titanium-rich slag. About ready to design a semi-commercial plant for continuous metal production. Pilot work was done by Battelle.

Monsanto Chemical Co. In cooperation with National Research, has worked out a number of processes on small scale. Two may have commercial possibilities and one is said to require substantially less capital than a Kroll plant, to produce crystals which can be treated like sponge.

National Distillers Products Corp. Engaged in research.

National Research Corp. This pioneer in titanium development joined forces with Monsanto in 1950.

New Jersey Zinc Co. One third owner of Quebec Iron & Titanium. Developed smelting process used by that company to produce iron and a titanium-rich slag from ferruginous ilmenite.

Republic Steel Corp. Developing a 25-million-ton rutile mine in Mexico with production expected to start in 1955. No present plans for producing metal but will expand activities in processing it.

Titanium Metals Corporation of America. Owned by National Lead and Allegheny-Ludlum, TMCA is producing 10 tons a day at Henderson, Nev., and negotiating with GSA for an additional capacity of 5,400 tons per year. World's largest integrated plant, it uses Australian rutile in a modified Kroll process. Fabrication is carried out in the various Allegheny plants. Company is said to be spending almost $2 million a year on all phases of titanium research.

Union Carbide & Carbon Corp. Building a 7,500-ton per year plant at Ashtabula, Ohio, that will employ sodium reduction of $TiCl_4$. Present plans go no further than sponge, but may eventually include metal processing.

Western Pyromet. Has leased an idle magnesium plant from GSA for its pilot work.

This compilation of activity in the titanium industry is based on published data.

REPRINTS

REPRINTS of Prof. Kellogg's report, "What The Future Holds For Titanium" plus the capsule summary of present activity above, are available. The price is 50c.

You may also wish to obtain reprints of "World's Major Titanium Mine & Smelter Swing Into Full Scale Production" (12 pp), a complete description of Quebec Titanium's operations at Allard Lake and Sorel. Price—35c.

For either or both of these reprints write to

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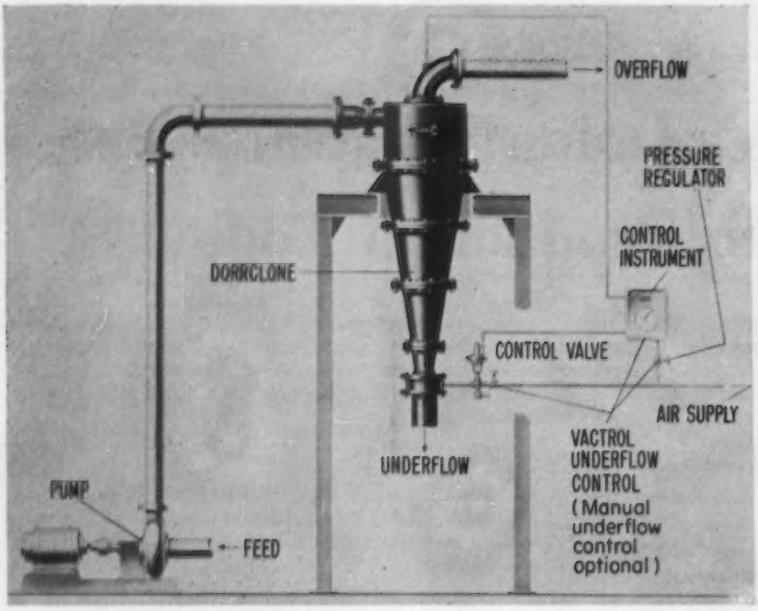
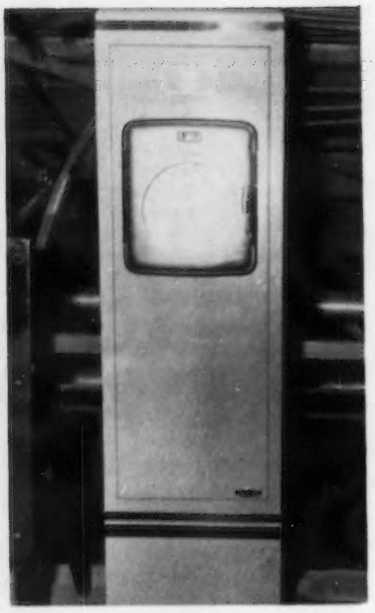


Schematic diagram indicates arrangement of cyclone and controlling Vactrol unit. Controller automatically maintains fixed percentage solids in underflow despite feed.



Control instrument regulates underflow density through apex valve on cyclone.

Wet Cyclone Eliminates Bottleneck Caused by Too Many Fines

PERIODIC DECREASES in plant capacity due to over-abundance of fines in the feed have been eliminated at Quincy Mining Co.'s reclamation plant at Hubbell, Mich., by using a 24-in. DorrClone equipped with Vactrol underflow control. This unit, which can be turned on and off at will, feeds a dewatered, deslimed, and polished product directly to the flotation cells. Before the installation of the DorrClone large volumes of minus 48 mesh material could not be handled, and the absence of a suitable ball mill feed resulted in curtailed production.

The Quincy reclamation plant was built in 1943 to recover much needed copper from the jig and table tailings of the old Quincy mill. These products of the "pre-flotation era," an accumulation of over thirty years, were deposited in Torch Lake. The original mine and plant, which fell victim to 1932 copper prices, were reopened in 1937 and operated until the end of World War II. The ore contains native copper, running less than one-half of one percent copper, while the gangue is largely silica.

Feed is recovered from the lake by a dredge and pumped to a storage pool near shore. Pumped from the storage pool it is deslimed, ground and floated. The filtered concentrate, averaging about 45% copper, is shipped to the nearby Quincy smelter at Hancock for smelting and refining. The accompanying flowsheet illustrates the plant circuit.

While the operation in itself is not unusual, the inter-relationship of the dredge, storage pool, V-tanks and grinding circuit makes plant capacity directly proportional to the amount of minus 35 mesh material in the make-up of the feed.

Feed Varies

This feed varies both hourly and seasonally, according to the position of the dredge and the plant intake line. In winter the dredge cannot be moved, and the plant must accept whatever feed it receives. In the summer, freedom of dredge and suction line movement allows some control of the plant feed.

The 5,000-ft, 20-in. diameter line from the dredge discharges through a one inch rubbish screen into the shore storage pool. Plant feed is withdrawn from this pool by means of a suction line mounted on a semi-circular track. Location of the suction intake affects the amount of minus 35 mesh material in the feed, and it is moved about every 10 minutes in an effort to minimize segregated feed to the plant.

From the shore pool, the slurry passes through a half inch rubbish screen, then into three drag classifiers, making a 28 to 35 mesh separation. The rake product discharges directly onto a belt and is conveyed 250 ft to the ore storage bin in the main plant. The single bin discharges into a launder feeding six 8x6-ft ball mill-classifier circuits. Three Forrester air cells receive the classifier overflow.

When the DorrClone is not in operation, the minus 28 mesh drag classifier overflow is dewatered in two stages of V-tanks. Overflow from these tanks goes back to the storage pool at the head of the system. Underflow from the second V-tank goes to two 35 ft Dorr thickeners for further con-

Probe for controller projects from overflow of 24-in. rubber-lined DorrClone.

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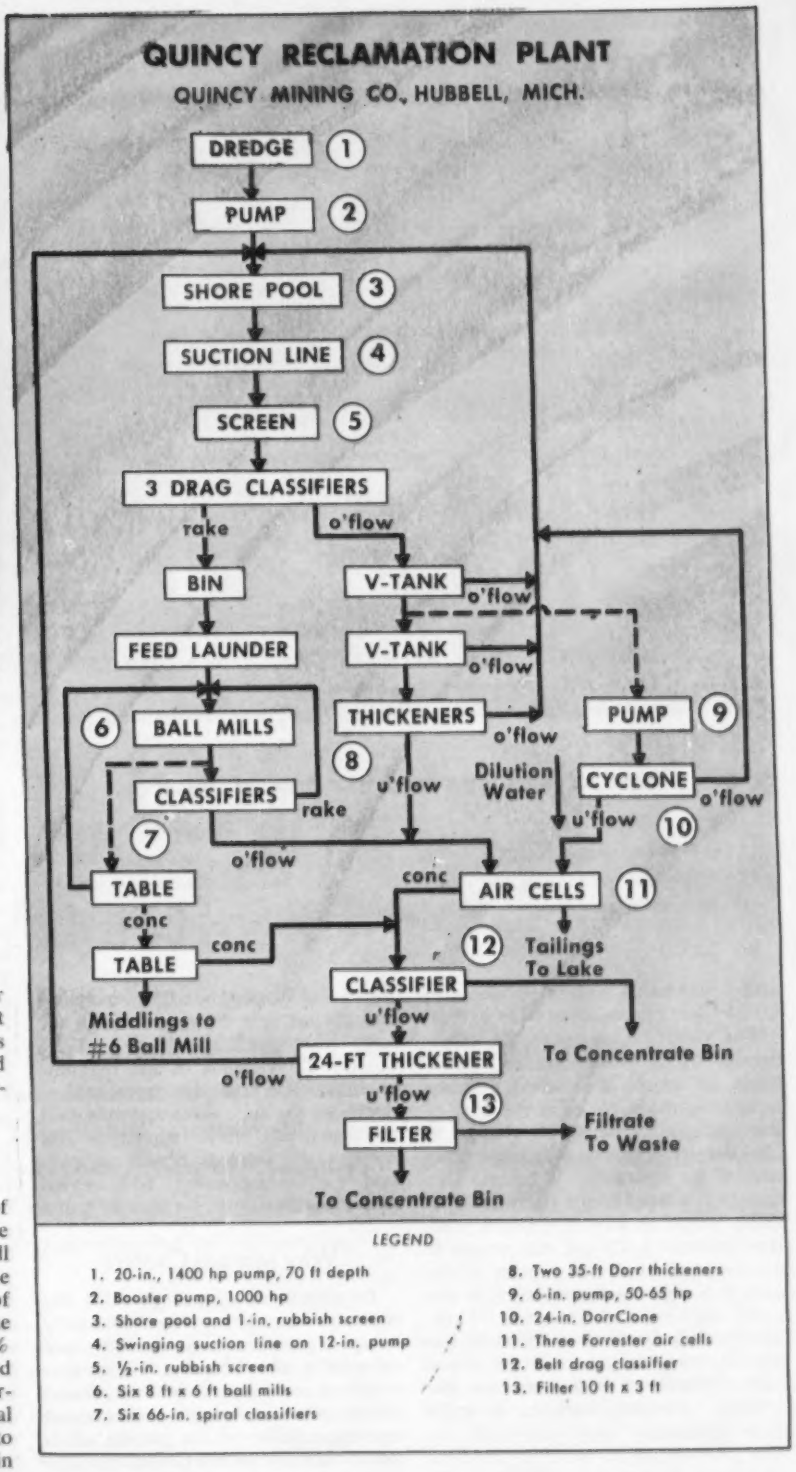


centration, then joins the classifier overflow from the grinding circuit at the head of the flotation circuit. This is the same system as was employed prior to the installation of the DorrClone.

Where the Cyclone Fits In

When there is a large volume of minus 35 mesh material entering the plant and insufficient feed to keep all six ball mills running, part of the spigot product from the first set of V-tanks is fed directly to the cyclone at concentrations of from 2 to 35% solids. Cyclone overflow is returned to the storage pool, and the underflow goes directly to flotation. Manual additions of water are necessary to maintain the proper pulp density in the cell. The changeover is accomplished by merely turning on the cyclone feed pump. The DorrClone does not run continuously but is used as a means of supplementing the existing dewatering equipment whenever necessary.

The DorrClone at Quincy is a standard 24-in. diameter unit with a rubber lined conical section and feed chamber of hardened Meehanite. It handles about 1,000 gal of feed per minute at a pressure of 20 to 22 psi. Feed density varies from 2 to 35% solids, and an average daily feed tonnage would be approximately 500 short tons. Hourly feed rate would vary from 14 to 30 tons. The underflow usually contains 66 to 72% solids, however, this is dependent upon the Vactrol setting. With a constant density in the underflow, the overflow fluctuates from 1 to 15% solids. Since its installation in July 1952, it is estimated that the DorrClone has oper-

TABLE I DorrClone Feed and Product Densities

	Case A	Case B	Case C
Feed, % Solids	3.17	6.23	26.55
Overflow, % Solids	1.02	3.39	11.82
Underflow, % Solids	66.1	66.4	66.3

TABLE II Screen Analyses of DorrClone Feed and Products

(Percent cumulative plus mesh)

Tyler Mesh	Case A			Case B			Case C		
	Feed	O'Flow	U'Flow	Feed	O'Flow	U'Flow	Feed	O'Flow	U'Flow
35	4.1		6.9	2.7		4.0	1.2		2.6
48	11.3		17.4	7.0		10.5	3.8		7.6
65	25.1		33.2	15.1		23.8	10.8		22.8
100	41.8		50.2	27.4		44.0	26.3	0.9	51.9
150	55.2		61.1	41.6	1.3	65.9	37.4	9.1	75.3
200	65.9	1.3	71.8	57.1	3.6	82.4	57.0	30.0	86.2
270	73.7	3.3	78.0	65.1	14.8	89.4	67.4	51.6	91.1
325	89.1	13.1	94.2	82.2	76.9	97.5	85.0	77.7	96.4

TABLE III DorrClone Feed and Product Volumes

	Case A	Case B	Case C
Feed Volume (approx.), gpm	1000	1000	1000
Overflow Volume (calc.), gpm	981	973	811
Underflow Volume (calc.), gpm	19	27	189

ated 3,000 hours with no evidence of wear or any maintenance costs to date.

The Vactrol regulates the underflow density by a pre-set control instrument, to which is attached a probe measuring the vacuum in the core of the operating cyclone. A change in feed density produces a corresponding change in operating vacuum. This change is relayed to the control instrument, which in turn operates a pressure booster. A 100-psi compressor is connected through this booster to the apex valve so that the pressure on the valve can be varied from 0 to 75 psi. The pressure booster, activated by the control instrument, adjusts the diameter of the apex orifice so that the original operating vacuum is once again attained.

Vactrol Operation

An example of the Vactrol operation is as follows: the controller is indexed to a point corresponding to an underflow density of 66% solids. At a given instant, the apex valve pressure is 40 psi, corresponding to a certain volume of underflow. As the percent solids in the feed increases, the volume of underflow increases and the air core entering through the apex is reduced, which in turn increases the vacuum in the overflow chamber. The control instrument then decreases the apex valve pressure, thus increasing the valve diameter. This restores the original pre-set vacuum and its corresponding 66% solids underflow density.

Why Manual Control

By adjustment of a single valve, the controller can be operated manually using a pressure gage on the apex valve as a control point. Under certain feed conditions it has been found advantageous to resort to manual operation. Although the percent solids would remain constant, wide fluctuations in underflow volumes required constant attention to the dilution water of the flotation cell. Hence, during periods of widely irregular feed, a fixed manual setting of the apex valve prevented overcorrection of cell dilution. Serious thought has been given to control of the cell level and dilution water via the same controller. However, such an installation has not been made up to this time.

Operating data, accurately compiled by Ed Hauswirth, plant foreman, and his operators, indicate the strict limits within which the underflow density may be controlled with the Vactrol on automatic operation. As shown in Table I the feed to the DorrClone in three instances varied from 3 to 26.5% solids, yet the underflow density varied only from 66.1 to 66.4% solids.

Size Distribution

The particle size distribution of the feed solids was different in all three cases (Table II) depending upon the position of the plant intake line. In the first instance, the DorrClone made a 200 mesh separation on the coarsest of three feeds. As the feed became denser and contained more fines, as in Case B, more solids were diverted to the overflow with the result that only a 150 mesh separation was effected. With the thickest feed, Case C, only a 100 mesh separation could be achieved while the underflow density was maintained constant.

Variation in DorrClone underflow volume in these three tests is also of interest. The unit was designed to handle 965 gpm of slurry and the flow was measured at 1,012 gpm during initial operation. Because of the large volume of slurry being processed, no provision has been made at the plant to measure accurately the three flows. Based upon an estimated flow of 1,000 gpm, overflow and underflow volumes in the three tests have been calculated from the percent solids and specific gravity of the solids and are shown in Table III. It is felt these volumes are accurate within 10%.

When feed density was increased from 3 to 26% solids, the underflow volume was about ten times as great, and yet the underflow density remained constant. Overflow volume was, of course, more constant.

The DorrClone has proved invaluable to Quincy Mining Co. as a means of keeping the reclamation plant operating at full capacity. In addition to dewatering and desliming excessive fines, it is suspected that the scouring action produces a polished mineral surface, thereby increasing recovery. The added feature of the Vactrol controller has permitted regulation of the underflow density within very narrow limits during operational periods when the plant feed varied widely in particle size distribution. As evidenced by this operation, the Vactrol is applicable only in cases where feed is extremely variable and constant underflow density is required for optimum plant efficiency.

FIG. 1. ADVANTAGES of metallic selenium rectifiers include high overload capacity, efficiency, small size and low cost.

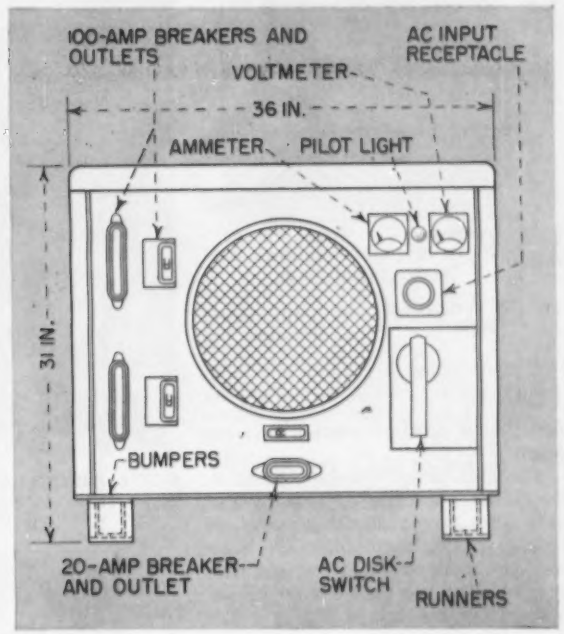


FIG. 2. SELENIUM RECTIFIERS are designed for heavy duty. Heavy steel runners and bumpers permit easy towing.

Six Required Specifications For Metallic Mine Rectifiers

They must:

1. **Stand-up to 150% load for ten minutes and 200% for one minute.**
2. **Be protected for short circuits, single phasing, overloads in excess of the above, and a reasonably unreasonable operator.**
3. **Operate in the worst combination of humidity, dust and dripping liquids.**
4. **Stand the abuse of being dragged over rough terrain.**
5. **Have accessible components and adjustments.**
6. **Be small and light.**

WILLIAM WARBURTON,
Design Engineer
and
S. P. JACKSON,
Advance Development Engineer
Metallic Rectifier Engineering
Lighting and Rectifier Department
Lynn, Mass.

THE TREND TO AC IN MINES is increasing for technical and economic reasons, and with it comes the emphasis on converters for localized blocks of dc power. Mine applications require rugged construction. Any power supply which is to last in this service must meet the specifications enumerated above.

These requirements have led to development of metallic rectifier power supplies with selenium cells as a rectifying medium. (See Fig. 1.)

These metallic rectifiers equipped with selenium cells meet these industry requirements satisfactorily because of their high overload capacity, efficiency, small size and low cost. They overcome many of the inherent disadvantages encountered with mercury-arc rectifiers, such as complicated coolings, difficulty of movement, and other handicaps.

Fig. 3 shows the volt-ampere curve of a selenium cell. When current flows in the forward direction, there is a very low voltage drop across the cell, even with large currents flowing. In the reverse direction, the cell has a very high voltage drop with even minute amounts of current flowing. Thus, current may flow freely in one direc-

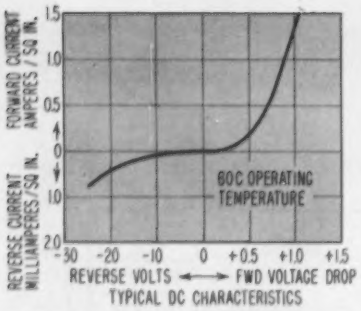


FIG. 3. VOLT-AMPERE curve shows easy current flow in one direction, but not reversed.

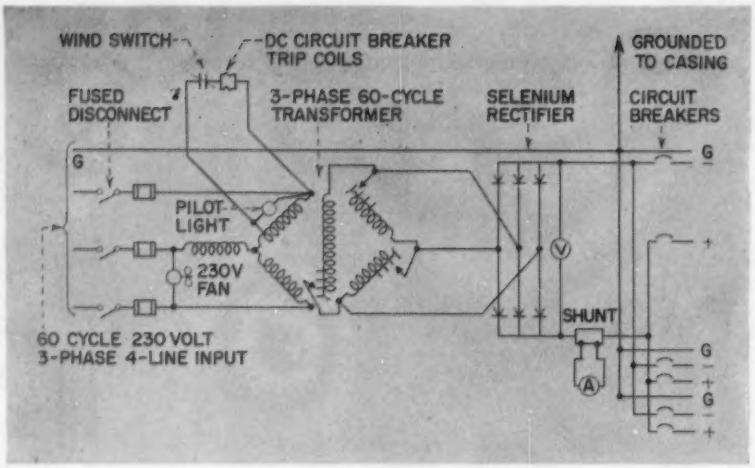


FIG. 4. CIRCUIT DIAGRAM for a selenium rectifier can be extremely simple as shown above. A circuit breaker protects unit if short occurs across any dc lines.

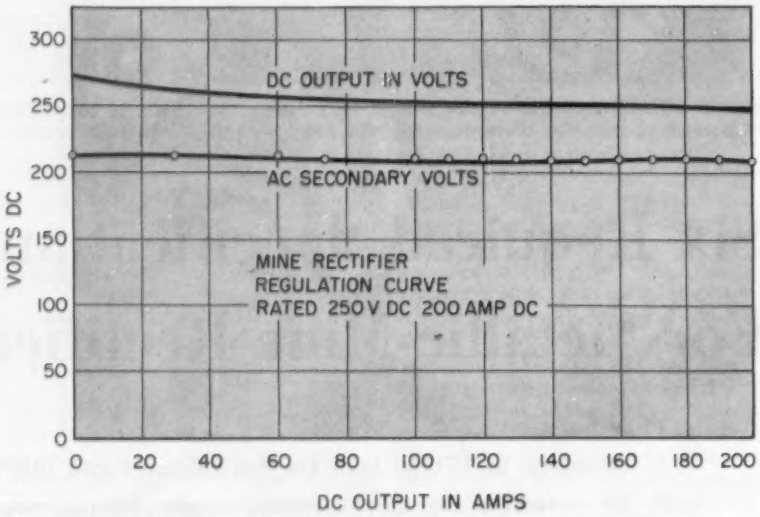


FIG. 5. INHERENTLY HIGH EFFICIENCY of the mine power supply using metallic rectifiers is shown. Note wide operating range for 80% efficiency.

tion, but is opposed when it reverses polarity.

The area under the static curve is the power converted to heat by the cell. Since this is unusable power, it reduces the efficiency of the unit. Note the very small losses in the selenium cell. This low loss means lower power costs. High conversion efficiency accounts for this low loss. Also note that the low forward voltage drop results in very good regulation.

High Power Factor

At power supply frequencies, the selenium cell may be represented by a variable resistance. The power factor, therefore, is very high.

The life of a selenium rectifier can be broadly defined as the operating time required to double the initial cell resistance. Usually this life represents 60,000 to 80,000 operating hours if proper care is taken in applying the cells. It should be noted at this point that life is not terminated in a metallic rectifier by complete failure. It is represented by a gradual deterioration of the output voltage because of an increase in resistance of the metallic rectifier. At the end of its usable life, as defined, the metallic rectifier power supply is still putting out voltage and is in perfect condition to supply the load. However, the losses are higher and the output voltage is beyond the point where it can be corrected by taps on the transformer.

To obtain long life, the heat must be conducted away from the cell speedily to reduce its temperature rise and also keep the current density down. In order to withstand heavy overloads, the equipment can be designed to have a current density that is normally acceptable to the industry at 150% overload. This means that at 100%, the current density is extremely conservative and at 200%, it is by no means unreasonably high.

To keep temperature of the cells down, an axial flow fan can be used with a filter supplied to remove abrasive particles and dust encountered in mine atmospheres. Thus, only clean air will flow over the transformer and rectifier stacks. Furthermore, if the filter becomes clogged or the air flow stops for any other reason, a vane-type wind switch can be provided to throw off the dc power circuit breakers.

What Kind of Transformer

In these applications, also, the transformer used should be of the two-winding variety with a wye-connected primary and a delta-connected secondary, to distribute the high currents required by the application uniformly throughout the conductors. Taps can be provided on the secondary to take care of variations in supply voltage and to obtain rated output voltage throughout the life of the unit (aging). It is important that the surface of the transformer be sealed completely to withstand high humidity. This type finish is technically available now. In some cases the finish has been tested by suspending transformers over acid tanks to see if acid fumes could penetrate the coating. After weeks of testing there was no noticeable corrosion of the iron or the copper in the transformer.

Simplicity Emphasized

Note in Fig. 4 that the circuit for a selenium rectifier can be extremely simple, also that with the disconnect switch closed, power is available at the dc circuit breakers. These breakers, rated to stand overloads, will trip

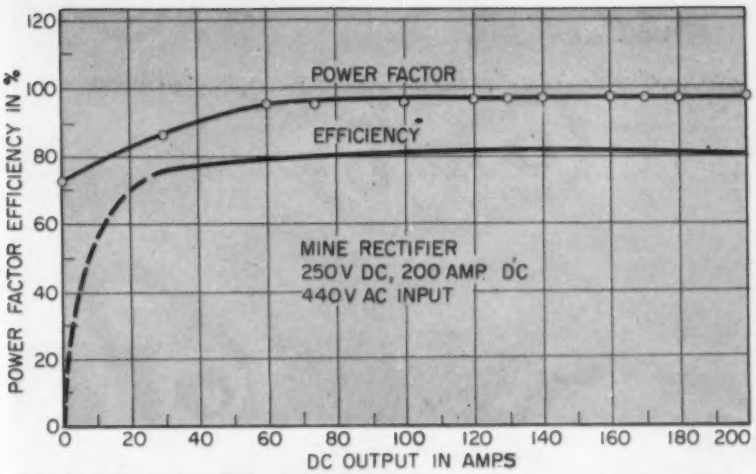


FIG. 6. POWER FACTOR of selenium rectifiers is extremely good, even down to low output. These figures were plotted from an application with resistance load.

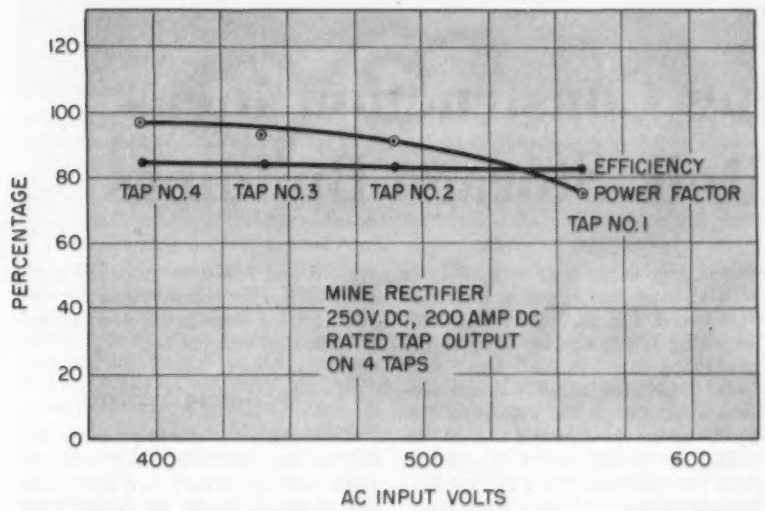


FIG. 7. SLOPE OF THE REGULATION CURVE is important since this curve may be extrapolated to indicate voltage at the rectifier at heavy overloads.

under severe or prolonged overload and prevent damage to the selenium rectifiers. Normally closed contacts of a vane-type wind switch are connected in series with the trip coils of the two 100-amp circuit breakers to prevent damage caused by failure of the cooling air supply. The 20-amp circuit breaker is not affected, since this amount of power would not harm the unit even without air flow. Note that if a short circuit occurs across any of the dc lines, the power supply is protected by a circuit breaker. If a short circuit occurs within the unit, the fuses in the disconnect switch will protect the incoming lines by removing the unit from the line. The interrupting fuses, of course, must have sufficient interrupting capacity depending on the short circuit current of the ac supply.

More Protection

Note also that in a selection unit, complete protection against single phasing can be provided by connecting the fan across the line and the trip coil in the opposite phase. Thus, if the phase containing the trip coils opens up for any reason, full voltage remains on the fan so that full cooling is maintained. Under this condition, even at rated current output, the selenium rectifiers operating single phase would be overloaded by only 30%. Since the fan is operating normally, the leakage losses in the rectifiers are considerably reduced, and because voltage output is reduced (250 down to 140), the chance of damaging the unit is eliminated. If either one of the other two phases open, the fan would be de-energized and the wind switch would apply voltage to the circuit breaker trip coils. In this case, the trip coils necessarily would be rated to operate at the reduced single phase voltage regardless of a change in line voltage variation.

A red pilot light across the phase supplying voltage for the trip coils gives indication that the ac voltage is applied to the unit.

The ac disconnect switch can be provided with time-delay fuses for maximum protection consistent with the overload requirements of this application. Fuses with interrupting capacity to match the available short circuit current must be used.

Heavy Duty Service

Selenium rectifiers are well adapted for heavy duty mine service. The casings are streamlined in appearance and dripproof, with easy access provided to controls, instruments, and outlets. Disassembly is no problem even after the unit has been exposed to a humid, corrosive atmosphere. Heavy runners and bumpers permit easy towing of the unit from either end. Fig. 2 illustrates a 50-kw unit.

In summation, Figs. 5 and 6 show the inherently high efficiency of the mine power supply using metallic rectifiers. Efficiency of better than 80% is provided from full load down to 40% load. Even at 15% of full load output, efficiency is better than 75%.

The power factor is extremely good even down to low output. Over most of the range it is better than 95%. Note that Figs. 5 and 6 were plotted using a resistance load.

Regulation, as shown by Fig. 7 is approximately 12½% full load to no-load, and 5½% full load to ¼ load. This remarkably low regulation is especially advantageous in this service, where regulation of dc cables and of the ac system contributes to low dc voltage at the point of operation.

The slope of the regulation curve at full load is very important, since this curve may be extrapolated to indicate voltage of the rectifier at heavy overloads. As is typical of selenium rectifiers, most of the regulation occurs below 25% load so that the slope of the curve at rated load is such as to give very favorable regulation at heavy overloads.

The unit shown is a 50-kw unit rated at 250v dc and 200 amp dc continuous. The overload rating is 300 amp for ten minutes infrequently applied and 400 amp for one minute infrequently applied. Each 100-amp circuit is capable of carrying 50% of the above overloads. An auxiliary circuit for hammers, drills and other tools, is also provided.

INTERNATIONAL MINERALS & CHEMICAL CORP.'S new 100,000 ton bulk storage building at Carlsbad, N.M. is fully equipped with modern conveying and reclaiming units. The reclaiming system can handle 250 tons of potash per hour.

Cost-Cutting Construction Ideas For Huge Bulk-Storage Buildings

A. B. CHAFETZ, Assistant Superintendent, Maintenance and Engineering, and W. A. SEEDORFF, Mechanical Engineer, International Minerals & Chemical Corp., Carlsbad, N. M.

INTERNATIONAL Minerals & Chemical Corp.'s new 100,000-ton bulk storage building at Carlsbad, N. M., incorporates the combined ideas of the engineer-contractor and International's engineering staff. The building is an imposing structure of 600 tons of steel covered with treated corrugated roofing on 4500 cu yd of concrete. It is 150 ft wide, 500 ft long, and 70 ft above the floor at the highest point.

Preliminary studies of the most efficient combination of concrete wall height and building size indicated a structure of the arch-rib type of concrete walls 15 ft high. Construction of the 15-ft high, 20-ft long, and 10-in. thick reinforced concrete walls is of the tilt-up type used for many years in Europe and more recently in this country. After machine excavation of 25,500 cu yd by bulldozers and Carryalls, the footings and 12-ft high pilasters were poured. Following this phase, the 6-in. slab floor was poured to grade. After the curing period for the slab, all 62 wall sections were cast on the floor adjacent to their ultimate vertical locations. Cast in each slab were twelve 1-in. threaded inserts with projecting spider legs for tying to the reinforcing steel. A "stiff back" steel frame fabricated of wide flange sections was bolted to the wall section by means of the steel inserts cast in the walls. About 500 cu yd of concrete walls were tilted in place by one tire-mounted crane in 4 days when using two of the "stiff backs." See illustration. Each wall section weighed about 18 tons. Estimated savings resulting from this tilt-up type construction over conventional forming and pouring are about $14,000.

Since all of the building reactions were designed to be taken by the 12-ft high pilasters, wall sections were merely bolted to the pilasters with standard 6-in. channel sections using impregnated felt stripping as a seal. Standard expansion joint material was used under each wall section. The weight of the wall exerted sufficient pressure to squeeze the material and form a seal.

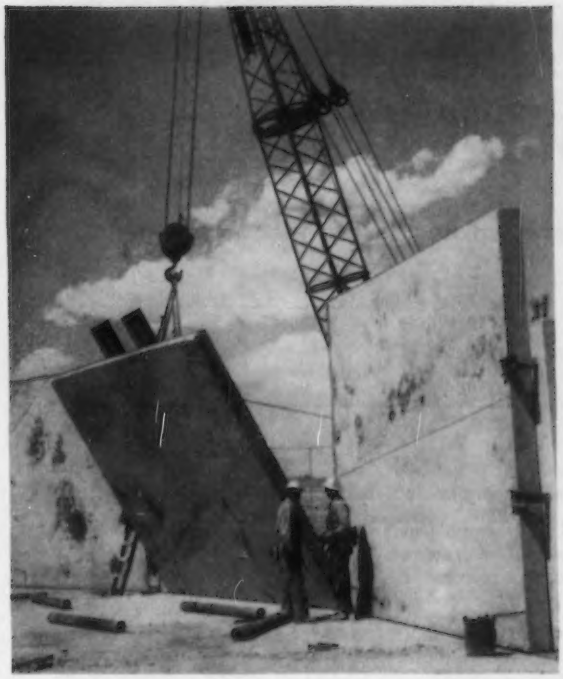
Erection of the arch ribs by a tire-mounted crane proved a fascinating sight as one-half of each arch (55 ft high and cantilevered from the pilaster about 70 ft) was raised in place, bolted to the pilaster and allowed to hang unsupported until the other half arch and horizontal top member were erected and joined to make the complete arch. The structure was covered with treated corrugated roofing and flood-coated with hot tar.

Reclaiming System

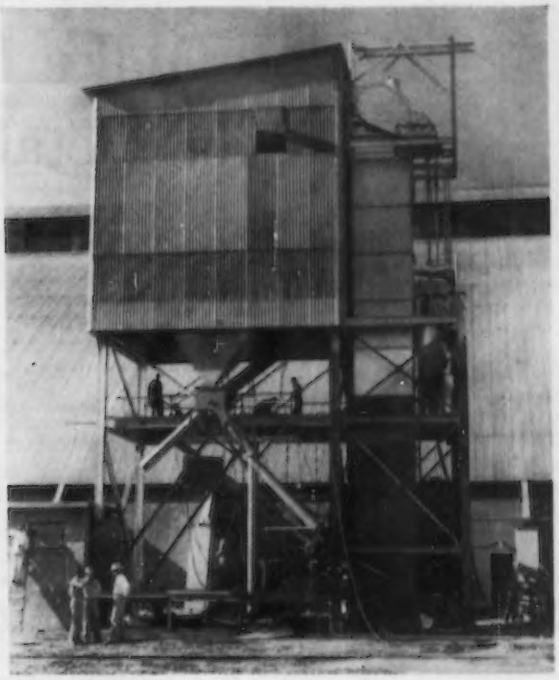
To reclaim the stored product, two underground concrete tunnels with belt feeders and conveyors, 90 ft from each side of the transverse centerline of the building, were planned. The tunnels run under the entire 150-ft width of the building with access openings at both ends. At the deepest point the tunnel is 20 ft underground and inclines to the surface level on the load-out side. Since immediate future storage requirements were estimated at about half of the building capacity, only one tunnel was equipped with machinery. The other was sealed off for future use.

In general, the entire reclaiming system is designed to handle a minimum of 250 tph and to take advantage of the free-flowing characteristics of the potash. To envision the maximum pile to be reclaimed, imagine a transverse cross-section through the storage pile as a rectangle 150 ft wide and 15 ft high topped by a triangle 150 ft on the base and 45 ft high.

Since the tunnels are planned as duplicates and only one is equipped, the remaining discussion will mention



18-TON TILT-UP CONCRETE WALL SECTIONS whittled down construction costs of buildings by approximately $14,000.



RECLAIMED BULK POTASH goes from underground belt through bucket elevator to this car loading station at trackside.

only one. On the longitudinal centerline of the building at the floor level is a 12-ft square grizzly. Normal production from the refinery is dispatched directly to this grizzly and hopper by means of a 24-in. wide and 176-ft long shuttle belt conveyor housed in a covered gallery on top of the building. With the pile at maximum height, a gravity draw-off of 6,000 tons is realized by the operation of one belt feeder and one conveyor. The crater left, and all of the remaining product are moved to another grizzly and hopper (10 x 12 ft) adjacent to the wall by means of a 4-yd scraper bucket powered by a double-drum hoist operating at a maximum speed of 300 fpm. Under this hopper is a 30-in. belt feeder conveyor which discharges to the other conveyor. With these two systems, each designed for 250 tph, it is a simple matter to reclaim at the designed through-put tonnage by either or both as conditions dictate. This built-in factor of safety assures the car loading station of a constant tonnage to hold peak efficiency with minimum manpower.

Scraping System

The double-drum hoist or scraper unit is powered by a 15-hp, 440-v, 1200 rpm, TEFC wound-rotor motor with variable speed control actuated by either of two 5-position controllers at the operators' stations. The clutches are air operated by electrically controlled solenoids receiving intelligence from either of the 3-way master switches also in the operators' stations. The path of the scraper bucket can be repositioned over the entire 70,000 sq ft of floor area by a remotely controlled trolley-mounted sheave. By this arrangement, the scraper bucket can move material to any of the four grizzlies.

The operators' stations were designed for maximum human comfort, safety, and visibility. To insure these goals, the two stations were installed 20 ft above the floor, projecting 7 ft into the building, and immediately near the grizzlies next to the wall. The blister-type stations are fabricated of steel plate and safety glass, sealed from dust, and air-cooled by evaporative air conditioners used extensively in the Southwest where low relative humidity permits.

Crushing and Loading

The belt conveyor from the ground tunnel discharges to a continuous bucket elevator next to the railroad tracks. The product is then fed to a 5 x 12-ft vibrating screen operating in open circuit with a 24 x 30-in. crusher. Screen undersize and crushed oversize fall by gravity to a 24-in. high-speed belt-type slinger for box-car loading or to a pipe for hopper car loading. Since all cars are loaded while on the scale, the scale beam was fitted with a micro-switch. When the desired tonnage is reached, the scale beam actuates the switch which in turn shuts down the entire system back to the grizzlies.

Dust Control

To control dust in the tunnel, a 5000-cfm, cyclone-type dust collector was installed in the load-out building and a header extended to each of the dusting belt transfer points in the tunnel. Accumulated dust and spillage in the tunnel are collected by a 2-tph vacuum cleaning system installed next to the dust collector with a 4-in. header running the entire length of the pit. At various locations are valves with spring-loaded covers to receive a 50-ft length of flexible hose and gulper nozzle. Cleaning of the concrete walls and machinery is accomplished in the same manner by units used in homes.

The entire operation of reclaiming by either gravity and/or scraping, conveying, screening, crushing, loading, weighing, and car spotting is now done by two men. Pushbutton controls for all equipment except the scraper unit are remotely located in one panel in the scale house at the railroad track.

International feels that the project described is a step forward in the interests of automation and human engineering as well as an attempt to introduce improved methods.

How to Make Faster Analyses for Better Metallurgical Control

JORMA KINNUNEN
BERTIL WENNERSTRAND
Outokumpu Oy, Metalworks
Pori, Finland

ACCURATE ANALYSIS OF ORES, concentrates and tailings for better production control in the mill can be made in 30 minutes using ethylenediamine tetra-acetic acid (EDTA) recently introduced by Schwarzenbach and his co-workers. This compound permits rapid and accurate volumetric determination of calcium, magnesium, zinc, nickel, cobalt, iron, aluminum, copper, cadmium, lead and mercury in pure solutions. With suitable masking agents it is possible to remove interference of some metals and assay for others.

Here is how the various metals can be titrated and masked:

Titration and Masking

Calcium-magnesium is titrated in an ammoniacal solution using Eriochrome Black T as indicator but can be masked with ammonium fluoride or by lowering the pH of the solution to 6.8.

Manganese is titrated under the same conditions by adding a reducing agent such as ascorbic acid or hydroxylaminehydrochloride, but can be masked with great amounts of cyanide. Interference of traces of manganese can be avoided with a reducing agent.

Zinc is also titrated in ammoniacal solution but can be masked by cyanide and demasked with formaline or chloralhydrate.

Cadmium behaves like zinc except that it can be further masked with sodium diethyldithiocarbamate.

Iron is converted in a slightly acid hot solution, into potassium ferrous cyanide by adding a reducing agent such as ascorbic acid or hydroxylaminehydrochloride and potassium cyanide. It cannot be demasked with formaline.

Aluminum in small amounts does not interfere in ammoniacal solution. Greater amounts can be masked with ammonium fluoride (2) or pyrocathecol (13).

Lead is titrated in an ammoniacal cyanide solution in presence of tartrate (10) but can be masked by adding sodium diethyldithiocarbamate (11). Since a large amount of tartrate is harmful, the use of mannitol is often preferred.

Copper, cobalt, nickel and mercury can be masked in an ammoniacal solution with potassium cyanide. These metals are not demasked by formaline or chlorolhydrate (6,7,8). The interference of traces of heavy metals can be avoided also by adding sodium sulphide.

These facts form the foundation for the determination of copper, iron, lead and zinc in ores, concentrates and tailings. Calcium, magnesium, manganese and cadmium can also be determined.

If required, copper and iron can first be determined idometrically using ammonium bifluoride (14). Then copper, iron, nickel, cobalt, zinc and calcium + magnesium are masked with cyanide and fluoride, and lead (+ manganese) is titrated. Then zinc (+ cadmium) is titrated after demasking for formaline.

Accuracy of Rapid Analysis Method

Material	Cu %		Fe %		Pb %		Zn %	
	Pres.	Found	Pres.	Found	Pres.	Found	Pres.	Found
Cu-concentrate	24.88	24.87	24.54	24.88	4.58	4.51	8.48	8.61
Pb-concentrate	3.45	3.38	7.43	7.48	50.50	50.41	10.05	10.30
Zn-concentrate	1.73	1.70	10.05	10.40	1.18	1.10	49.50	49.65
Ore	0.79	0.78			1.25	1.14	4.20	4.30

Procedure for Assaying Copper, Lead and Zinc Concentrates

1. Dissolve 0.5 g of sufficiently finely ground sample (0.25 g of copper concentrate) in a 600 ml beaker with 2 ml of bromine and 10 ml of concentrated nitric acid. Add to the solution concentrated aqueous ammonia until some precipitate is formed, and cool the solution.

2. Add ammoniumbifluoride until a blue color appears, or iron precipitate is dissolved. Add then 25 ml of 8% potassium iodide and titrate copper with 0.05 N sodium tiosulphate solution using starch or thiodene as indicator.

3. After copper titration add about 1 g of boric acid and 10 ml of nitric acid (1 + 1) free from oxides of nitrogen and titrate iron with sodium tiosulphate solution.

4. Neutralize the excess of acid with concentrated aqueous ammonia and add into hot slightly acid solution about 1 g of solid ascorbic acid, about 5 g of mannitol, 10-12 ml of 20% potassium cyanide solution and 20 ml of aqueous ammonia. Then add 5-10 g of ammonium fluoride, about 15 g of solid ammonium acetate and heat nearly to boiling. Titrate in the cooled solution Pb (+ Mn) with 0.01-0.05 N EDTA solution adding some manganese salt of EDTA and using Eriochrome Black T as indicator. In the case of lead concentrate, add 1-2 g of citric acid instead of mannitol.

5. After lead titration add repeatedly formaline solution (about 30-50 ml) and titrate between formaline additions zinc with 0.5 N EDTA until the color turns to blue.

Procedure for Assaying Tailings

Dissolve 1-2 g of sample with few drops of bromine and 15 ml of concentrated nitric acid. Add about 5 g of tartaric acid and about 3 g of sodium pyrophosphate and make the solution ammoniacal (pH-9). Cool the solution and transfer into a separating funnel and add 2% sodium diethyldithiocarbamate solution until no further precipitate forms (about 20 ml). Extract twice with 15 ml of chloroform. Combine the chloroform extracts, add about 10 ml of nitric acid (1 + 1) and heat until chloroform is evaporated. Neutralize the residue with concentrated aqueous ammonia and continue as before.

If only zinc is to be determined it is preferable at once to mask copper and iron and titrate lead + calcium + magnesium then demask zinc with formaline and titrate it as usual. The procedure is outlined below.

Steps 2 and 3 can be omitted if copper or iron content is not required.

If lead is lacking or not to be determined the addition of fluoride and the heating of solution in the Step 4 can be omitted. In this case Ca + Mg + Pb + Mn is titrated. Also some sodiumdiethyldithiocarbamate or thioacetamide can be added to mask lead.

By adding sufficient potassium cyanide it is also possible to mask manganese. It is probable that with appropriate modification the procedure can be used also for manganese ores and for determination of calcium and magnesium separately.

In Step 5 small amounts of cadmium can be masked with sodiumdiethyldithiocarbamate or thioacetamide in hot solution. If added after Zn + Cd titration an amount of EDTA equivalent to cadmium present is liberated and can be titrated with Zn solution.

As can be seen, the method is very versatile and can be used for a great variety of samples. Generally the metals can be determined simultaneously from the same initial weight. Depending on the metals present sometimes a separate initial weight is to be preferred.

Sometimes, especially in tailings, there are too many interfering elements present to be masked. In this case a modification is necessary. Fortunately the use of sodium diethyldithiocarbamate permits an easy separation of copper, lead and zinc by extraction with chloroform from interfering elements in an ammoniacal tartrate solution. Under same conditions cobalt, nickel and cadmium are also complete or partly extracted. Thus after extraction it remains only to destroy the organic solvent and continue as before. Procedure for tailing analysis is given on the previous page.

Procedures described below are suitable for daily control of flotation processes and for commercial analysis of concentrates. Copper, lead and zinc can be determined simultaneously in concentrates in less than 30 minutes. Zinc determination in zinc concentrate is possible in 15 minutes. In spite of this great rapidity, results are more accurate than in the conventional methods. See table on previous page.

Acknowledgment: The authors are indebted to Petri Bryk, general manager of Outokumpu Oy, for the permission to publish this paper.

E&MJ Salutes Verne Johnston

VERNE D. JOHNSTON, chief mining engineer for Oglebay, Norton & Co., Cleveland, is probably best known for his chart of projected production and consumption of iron ore—which he developed to the year 1981.

This guidepost for iron and steel, based on intensive study of every known source of ore production, requirements, and of potential imports and exports, was highly praised by the leading companies in the industry and gained international fame.

But Johnston's place in industry is based on much more than one survey. He has been a leader in the study and use of lean ores, a finder of huge and valuable deposits and a moving force in the encouragement of a bigger and stronger industry.

Verne Johnston accomplished all these things in the 41 years he has been employed by Oglebay, Norton and its affiliates. He retired from his post as chief mining engineer on Nov. 1, 1954—remaining as consultant for the company and for outside clients.

He numbers thousands of people, in and out of the industry, as his friends, and is constantly gaining more with what one acquaintance called "An unfailing knack of getting on friendly terms with all sorts of people in a hurry—and staying that way." One of the officers of Oglebay, Norton has said, "I don't know if you could say Verne has any particular hobby—except people. And he's been working at that hobby as long as I've known him."

He is an excellent story teller and knows hundreds of them.

Johnston's first important project was in assisting W. O. Hotchkiss, then state geologist of Wisconsin, in geologic and iron strata studies in the Gogebic range for the first comprehensive chart of the structure of that area.

In 1918, Johnston was assigned to the Oglebay, Norton field office in Ironwood as chief mining engineer.

He quickly became the company's tax expert; responsible for making appraisals on properties and conferring with state appraisers on valuations to be set for ad valorem taxes.

Early in the 1930's, such men as R. C. Allen and Johnston of Oglebay, Norton, and Joseph Frantz of American Rolling Mill Co., decided that eventually there would be a real market for lean, beneficiated ores, and they quietly began research work in that direction.

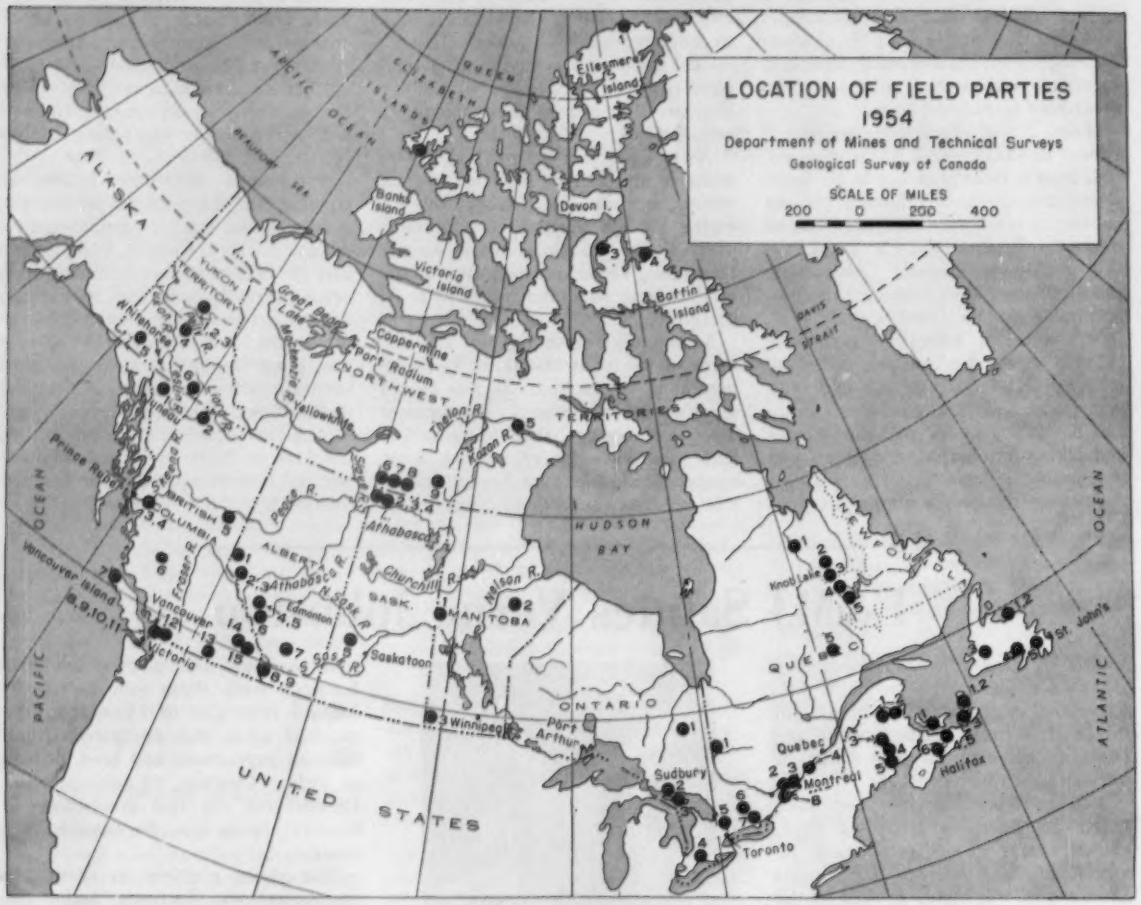
In 1937, Johnston and Robert Dickey, then head of the geological department of Michigan Tech, reported that probably the only worth-while holdings were those still owned by Mesabi Iron Co. in Minnesota, untouched since that company's beneficiation experiment had been shelved in 1924. Decision by Johnston and Dickey was the real conception of Reserve Mining Co., the taconite producer.

The major problem in furthering the project was financing, and a detailed look at just what the market for beneficiated ores would be in the future was demanded by lending agencies. Johnston developed the extremely detailed and coherent chart showing projected production and usage of all iron ores, both domestic and import, projected to 1981.

In 1941, Johnston was called in as an independent consultant for Sheffield Steel Co. in Kansas City, to locate and prove out sufficient ore in Texas to make construction of a blast furnace in Houston practical. He found a deposit of approximately 4-million tons of lean but usable non-Bessemer ore.

In connection with these same explorations, Johnston also performed consultation services for Arthur G. McKee & Co. in setting up washing plants for ridding the lean Texas ore of its high sand and clay content.

Johnston was also instrumental in the purchase by Kaiser Steel, in 1946, of its Eagle Mountain, Calif., iron ore properties. Working as a consultant for McKee, Johnston found that the property was a valuable ore source, and recommended to the Reconstruction Finance Corp. they loan Kaiser $1-million to purchase the lease.



Where Canada's Department of Mines Field Parties Operated in 1954

NORTHWEST TERRITORIES

1 Reconnaissance
North Ellesmere Island
2 Reconnaissance
Mould Bay
3 Reconnaissance
Arctic Bay
4 Reconnaissance
Pond Inlet
5 Operation Baker
Central Keewatin
6 Hill Island Lake W/2
7 Hill Island Lake E/2
8 Abitau Lake
9 Aeromagnetic Surveys
Southeast District of Mackenzie

YUKON TERRITORY

1 Kano Hill
2 Mayo District
3 Mayo Lake
Scougale Creek
4 Glenlyon
5 Kaskawulsh
6 Wolf Lake

BRITISH COLUMBIA

1 Atlin
2 McDame
3 Terrace
4 Granite Studies
Terrace
5 Palaeontology and Stratigraphy
Pine Pass and Peace River
6 Anahim Lake
7 Palaeontology and Stratigraphy
Northwest Vancouver Island
8 Tertiary and Pleistocene
Lower Fraser Valley
9 Palaeontology and Stratigraphy
Vancouver
10 Groundwater
Langley and Matsqui
11 Aeromagnetic Surveys
Southern Cordillera
12 Coquitlam
13 Kettle River
14 Lardeau
15 Palaeontology and Stratigraphy
Southern Rocky Mountains

ALBERTA

1 Two Lakes
2 Adams Lookout W/2
3 Adams Lookout E/2
4 Central Foothills
5 Palaeontology and Stratigraphy
Nordegg
6 Carboniferous Lithology
Nordegg to Banff
7 Pleistocene Geology
Beiseker and High River
8 Blairmore
9 Coal Reserves
Coal Fields

SASKATCHEWAN

1 Thluicho Lake and Harper Lake
2 Beaverlodge
3 Uranium Inventory
Beaverlodge
4 Milliken Lake
5 Pleistocene Geology
Battleford

MANITOBA

1 Schist Lake
2 Knee Lake
3 Pleistocene Geology
Virden

ONTARIO

1 Pleistocene Geology
Smooth Rock
2 Uranium Deposits
Blind River
3 Manitoulin Island
4 Oil and Gas Data
Southwestern Ontario
5 Groundwater
Simcoe
6 Mineralogical Studies
Wilberforce
7 Investigation of Iron Deposits
Southeastern Ontario
8 St. Lawrence Seaway Investigations

QUEBEC

1 Opasatika Lake
2 Pleistocene Palaeontology
Ottawa-Montreal
3 Radioactive Columbium Deposits
Oka
4 Pleistocene Geology
Aston, Yamaska, Three Rivers
5 Cooperation Dominion Observatory
Mouchalagan-Manicouagan

NEW QUEBEC-LABRADOR

1 Cambrian Lake and Herodier Lake
2 Ahr Lake
3 Burnt Creek
4 Menihek Lake
5 Pleistocene Geology
Dyke Lake-Ashuanipi

NEWFOUNDLAND

1 Twillingate
2 Palaeontology and Stratigraphy
Notre Dame Bay
3 Victoria Lake
4 Rencontre
5 Argentia and Dildo

NEW BRUNSWICK

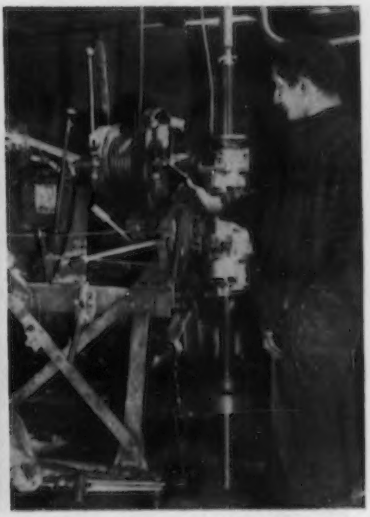
1 Tetagouche Lake
2 Bathurst Base Metal Deposits
3 Coldstream
4 Palaeontology and Stratigraphy
South New Brunswick

PRINCE EDWARD ISLAND

NOVA SCOTIA

1 North Cape Breton
2 Cape Breton Highlands National Park
3 Baddeck
4 Sydney-Truro
5 Stratigraphy and Palaeontology
Coalfields
6 Shubenacadie

DRILL CORES from Brunswick area are examined by Dr. G. S. Mackenzie, head, University of New Brunswick, department of geology, and C. S. Clements, director Mines Branch, Department of Lands and Mines of New Brunswick.



DIAMOND DRILLLING follows up areas pointed up by geophysical surveys in the booming New Brunswick area.

Unprecedented Exploration Programs Expand Canada's Mineral Wealth

UNLIKE EXPLORATION BOOMS of the past, Canada's current search is not limited to gold, silver, and the more common base metals. Today geologic, geophysical, and prospecting teams are adding uranium, lithium, asbestos, iron ore, mercury and others to list of minerals sought. The search goes on in the air, on land, and underground in an unprecedented effort to push Canada's mineral frontiers in all directions, even beyond the Arctic Circle. Evidence of this vast exploration program is reflected in the accompanying mineral map showing the location of field parties of the Department of Mines and Technical Surveys, Geological Survey of Canada.

Mineral Output Soars

If private surveys and exploration programs were indicated with superimposed black dots, many of the important mineral provinces on the map would be blacked out. All of this activity has been stimulated by the expansion of Canada's metal and nonmetallic mineral production which has pushed upward steadily from a value of $423-million in 1939 to an estimated $1,041-million in 1954. Canada's liberal encouragement to foreign capital has been another factor supporting the present exploration and development surge.

The Northern Miner, November 25, 1954, has prepared the following analysis of methods of discovery of some 30 orebodies in Canada:

Prospecting	53.3%
Diamond drilling	28.3%
Geophysics	18.3%

Some Significant Finds

Some of the recent geophysical finds include American Metal Co.'s property in New Brunswick; the Anacon and Austin Br. properties in New Brunswick; East Sullivan, Quebec; Quemont, Quebec; and Quebec Asbestos, Quebec. Dr. Arthur Brant, of Newmont Exploration, Ltd. reported the following in appraising magnetic methods: "The usefulness of magnetic methods[1]: "The usefulness of magnetic are exhibited by O. Weiss' work tracing iron formations into the Rand Extension, the extension of the Chesterfield Inlet nickel zone, the discovery of the first Lynn Lake nickel orebodies in Canada, the outlining of the ilmenites at Allard Lake, Que., and the discovery of magnetite near Morgantown, Pa., and Marmora, Ont., the last three resulting from airborne work by Aero Service Corp." Thus in this brief summary of worldwide magnetic surveys, the Canadian discoveries rank importantly.

The modern mode of attack in exploration campaigns includes geophysical, geological, and prospecting techniques reinforced by heavy diamond drilling programs. In some sensational cases the discovery of magnetic anomalies on airborne survey maps caused alert exploration engineers to move in fast and acquire options or claims. This approach is now so well known that one exploration engineer summed up the situation as follows. "If you see a magnetic anomaly on a map, jump in on the location, and sit on it."

Ore Seekers Are Learning

However this approach has not always been common. For instance, the famous Brunswick find is located on a magnetic high that appeared on an airborne survey magnetic map put out by the Canadian Department of Mines and Technical Surveys in 1950, but was strangely ignored by exploration engineers.

Subsequent exploration in New Brunswick made extensive use of geophysical methods and diamond drilling. Photographs of ground geophysical crews presented in this article were taken recently in the New Brunswick area. Magnetic, electro-magnetic, resistivity, and self potential methods

[1] A. A. Brant "The Role of Geophysical Methods in Modern Exploration Programs." *E&MJ,* Mid-March 1955.

ELECTROMAGNETIC SENDING. Dr. S. H. Ward of McPhar Geophysics, Ltd. orients coil which sends out 1,000-cycle electromagnetic waves penetrating earth's sub-surface to 500 ft or lower if necessary.

ELECTROMAGNETIC RECEIVING. Here Dr. Ward demonstrates simplicity of the apparatus required to pick up the electromagnetic waves produced by the coil at left. This method revealed Brunswick's important orebody.

Ground Crews Use Four Geophysical Methods In Brunswick

RESISTIVITY. Stirling Edwards of Geo-Explorers, Ltd. holds rod which is plunged into earth to search for sulphide conductors.

MAGNETOMETER. Donald Salt, partner-owner of Geo-Explorers takes a reading on the magnetometer in the Bathhurst mining area.

SELF-POTENTIAL. Don Salt demonstrates equipment to detect minute currents produced by oxidizing orebodies beneath the surface.

AIRBORNE MAGNETOMETER. Large twin-motored plane of Canadian Aero Service, Ltd., Ottawa, gets refueled for a major magnetic survey in Canadian northlands. Note the magnetometer mounted in the tail of the plane.

Aero-Magnetic Surveys Speed Search in Canada's Northlands

AIRBORNE MAGNETOMETER. Skilled flight crew studies flight assignments for the day.

AIRBORNE MAGNETOMETER. Canadian Aero's plane is covered up for night, ready for sub-zero morning exploration flight.

have been used. In some instances combinations of these methods have been used. For example, the electromagnetic method may indicate a good conductor—i.e. possible orebody. But since this favorable effect can be produced by graphite as well as sulphides, a follow-up survey by some other method may be in order to eliminate this area of doubt.

Airborne Prospecting

Inaccessibility of many parts of Canada, and the promise of huge rich mineral finds in undeveloped areas has forced the Canadian exploration crews to take to the air. Both the helicopter and the airplane have speeded up prospecting to such a degree that decades of prospecting time have been saved through airborne search methods. The well-known "bush pilot" has played an important part in expanding Canada's mineral empire.

Helicopters Speed Search

Helicopters fly less than 100 ft above the ground at speeds of 35 mph have been used to carry scintillometers for uranium exploration north of Uranium City. W. J. MacKenzie and George Warren, veteran mining engineers from Roan Antelope and Rio Tinto, respectively, recognized the value of the scintillometers and organized an exploration firm Helicopter Explorations, Ltd., for service in uranium areas. Large mining companies, including Eldorado Mining and Refining Ltd. took advantage of this new airborne exploration technique.

In some instances the helicopter is now used in conjunction with fixed-wing or conventional aircraft. The fixed-wing craft can cover hundreds of square miles in one day at altitudes of 400 to 500 ft flying at speeds above 100 mph. Localized investigations can be made with the helicopter to investigate anomalies disclosed by the faster airborne survey.

Helicopters have also been used to carry out magnetometer and seismic surveys. See pictorial presentation covering applications in Canada and elsewhere.

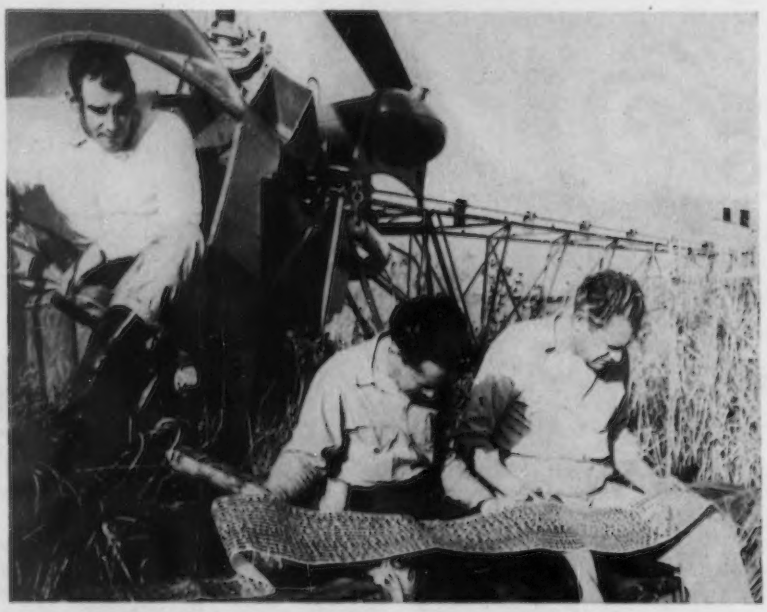
(*Please turn page*)

HELICOPTER MAGNETOMETER. Bell Helicopter is fitted with magnetometer for detailed survey in the wilds of Canada.

HELICOPTER SCINTILLOMETER. Modern helicopter equipped with scintillometer in New Mexico uranium area.

The following estimates of mileage covered in airborne magnetometer survey work in Canada since first surveys dating back to 1947 totaling nearly 1,000,000 miles, will give some idea of the importance of this type of exploration:

	Canadian Aero Service	Canadian Geologic Survey	Others (Estimate)
British Columbia...	51,500	10,000	—
Yukon Terr.	3,000	—	—
Northwest Terr.....	53,000	45,000	—
Alberta.....	110,000	52,000	30,000
Saskatchewan.	67,900	7,000	32,000
Manitoba....	38,600	—	6,000
Ontario.....	75,000	72,000	3,000
Quebec.....	101,600	95,400	14,400
New Brunswick.....	5,400	39,600	—
Nova Scotia..	23,900	—	3,600
Labrador.....	5,900	—	—
Newfoundland	—	—	36,000
Totals.....	535,800	321,000	125,000



HELICOPTER SEISMIC. Team on seimographic survey examines records in the field. Helicopter transports crews and all necessary instruments to inaccessible areas.

Illustrations of conventional aircraft and helicopters shown in this article emphasize the twin advantages of aerial exploration: (1) Fast, widespread surveys with conventional planes to reveal favorable areas for detailed investigation, and (2) slower methodical checks with geophysical instruments mounted in helicopters to pinpoint zones for diamond-drilling or further investigation by ground crews.

Where Will This Lead?

Since private capital is putting up huge sums to make these surveys possible, the answer is quite obvious. Investors will expect that mineral deposits discovered as a result of the accelerated search in Canada be put into production as soon as possible so that returns on investments will be commensurate with the risks taken. Accordingly, the current exploration boom with its reasonable share of sensational discoveries presages development of mines, mills, and smelters that will greatly enhance Canada's economy.

E&MJ extends thanks to William Gilman, Middletown Springs, Vermont, for the photos of ground crews in the Brunswick area; to Bell Aircraft Corp. for photos of helicopters in action, to Canadian Aero Service, Ltd. for the photos of amphibian and land planes in Canadian exploration areas, and to George Hanson, Director, Dept. of Mines and Technical Surveys, Geology Survey of Canada, for help in the preparation of the location map of mineral survey parties.

NEW BOOKS

Valuation of Alluvial Deposits. By H. L. Harrison. A revised edition covering valuation of alluvial and similar ore deposits. Published by Mining Publications, Ltd., 482 Salisbury House, London Wall, London, E.C. 2. Pp 308. Price 45s.

The Geology of the Mungana-Redcap Area, Chillagoe District. By E. Broadhurst. **The Effect on Metallurgical Recoveries of Inaccuracies in Assay Results.** By G. W. Walker. **Some Structural Aspects of Kalgoorlie Geology.** By S. A. Tomich. **The Occurrence of Gold Antimonide in the Antimony Veins of Costerfield, Victoria.** By F. L. Stillwell. Proceedings, Jan.-June, 1952, Australasian Institute of Mining and Metallurgy, Inc., Nos. 164-165. Pp. 91 plus maps, plates and figures. Bussau & Co., 289 Lonsdale Place, Melbourne.

California Journal of Mines and Geology, Volume 50, No. 1, January 1954. Contains the Annual Report of the State Mineralogist for the fiscal year July 1, 1952 to June 30, 1953, by Olaf P. Jenkins; California Mineral Commodities in 1951, by Henry H. Symons and Fenelon F. Davis; and Mines and Mineral Resources of Amador County, by Denton W. Carlson and William B. Clark. Pp 285, plus plates, maps, figures, tables. Price $1. Available from the State of California, Dept. of Natural Resources, Division of Mines, Ferry Bldg., San Francisco, Calif.

Facts About Titanium, by Robert O. Swenarton, Office of Minerals Reports, Bureau of Mines, Washington, D. C. Available from the Bureau of Mines Publications Distribution Section, 4800 Forbes St., Pittsburgh, Pa.

Mechanics of Materials. Third Edition. By Philip Gustave Laurson, and William Junkin Cox, both of the School of Engineering, Yale University. Published by John Wiley & Sons, Inc., New York 16, N. Y. Pp 414. Price $5.75.

Kempe's Engineer's Year-Book for 1955. 60th Edition. Edited by C. E. Prockter and B. W. Pendred. Chapters in Volume I include the following titles: Units of measurement, including conversion tables; basic mathematics and tables; mechanics; heat, optics, etc.; acoustics, vibration, and noise; electrical engineering; thermodynamics; hydraulics; theory of structures; engineering materials; plastics; iron and steel, wire ropes; cranes and appliances; liquid pumps; railway engineering; lubrication; and numerous others on power transmission and shop practice. Volume II contains chapters on electrical engineering; electronics; aerodynamics; gas turbines; internal combustion engines; atomic power; steam engineering; mining engineering; explosives; refrigeration; ventilation; surveying; building; concrete; depreciation; and related subjects. An excellent reference publication by Morgan Brothers, Ltd., 28 Essex St., Strand, London, W.C.2. Pp. 2760. Price, two volumes in case, 75c, plus postage.

The following publications may be obtained free from the U. S. Bureau of Mines Publications Distribution Section, 4800 Forbes St., Pittsburgh, Pa.:

United States Geological Survey Circular 263, Reports and Maps of the Geological Survey Released Only in the Open Files, 1952. By Donald R. Wiesnet, Lois E. Randall and Benjamin E. Jones. Pp 13, plus index.

USGS Circular 284, Computation of Peak Discharge at Contractions. By C. E. Kindsvater, R. W. Carter and H. J. Tracy. Offers method of measuring peak discharge by a survey of high-water marks and characteristics of the channel when current-meter measurements are not available. Pp 34, plus figures.

USGS Circular 296, Stratigraphy of the Wasatch Range Near Salt Lake City, Utah. By Arthur E. Granger. Pp 14, maps, tables.

USGS Circular 303, Stratigraphic Sections of the Phosphoria Formation in Montana, Part 2, 1949-50. By R. W. Swanson, E. R. Cressman, R. S. Jones and B. K. Replogle. Prepared as part of the program of the Dept. of the Interior for development of the Missouri River Basin, and of work done for the Atomic Energy Commission. Pp 21, plus tables.

USGS Circular 304, Stratigraphic Sections of the Phosphoria Formation in Idaho, Part 1, 1949. By R. P. Sheldon, M. A. Warner, M. E. Thompson and H. W. Pierce. Pp 30, plus tables.

USGS Circular 305, Stratigraphic Sections of the Phosphoria Formation in Idaho, Part 2, 1949. By D. F. Davidson, R. A. Smart, H. W. Pierce and J. D. Weiser. Pp 28, plus map, tables.

USGS Circular 307, Stratigraphic Sections of the Phosphoria Formation in Wyoming, 1949-50. By R. P. Sheldon, R. G. Waring, M. A. Warner and R. A. Smart. Pp 44, plus map, charts.

USGS Circular 309, Beryllium Resources of the Tin-Spodumene Belt, North Carolina. By W. R. Griffitts. Pp 12, plus maps, figures.

USGS Circular 311, A Fluorimeter for Solutions. A description of and complete drawings for the construction of a sturdy and versatile instrument for the measurement of fluorescence of solutions. Pp 9, plus figures.

USGS Circular 312, Yellow Canary Uranium Deposits, Daggett County, Utah. By V. R. Wilmarth. Pp 8, plus maps.

USGS Circular 313, Reconnaissance for Uranium-Bearing Carbonaceous Rocks in California and Adjacent Parts of Oregon and Nevada. By George W. Moore and James G. Stephens. Pp 8 plus maps, figures.

USGS Circular 316, Reconnaissance for Radioactive Deposits in the Eagle-Nation Area, East-Central Alaska, 1948. By Helmuth Wedow, Jr. Pp 9, plus maps.

USGS Circular 317, Reconnaissance for Radioactive Deposits in the Manley Hot Springs-Rampart District, East-Central Alaska, 1948. By Robert M. Moxham. Pp 6, plus maps.

USGS Circular 319, Reconnaissance for Uranium in the Lost River Area, Seward Peninsula, Alaska, 1951. By Max G. White and Walter S. West. Pp 4, plus map.

USGS Circular 320, Uranium Occurrences in the Golden Gate Canyon and Ralston Creek Areas, Jefferson County, Colorado. By J. W. Adams, A. J. Gude III, and E. P. Beroni. Pp 16, plus maps.

USGS Circular 321, Occurrences of Uranium-Bearing Minerals in the St. Kevin District, Lake County, Colorado. By C. T. Pierson and Q. D. Singewald. Pp 17, plus maps.

USGS Circular 322, The East Slope No. 2 Uranium Prospect, Piute County, Utah. By Donald G. Wyant. Pp 6, plus maps, tables.

USGS Circular 324, Stratigraphic Sections of the Phosphoria Formation in Wyoming, 1951. By T. M. Cheney, R. P. Sheldon, R. G. Waring and M. A. Warner. Pp 22, plus map, tables.

USGS Circular 325, Stratigraphic Sections of the Phosphoria Formation in Wyoming, 1952. By R. P. Sheldon, E. R. Cressmen, L. D. Carswell and R. A. Smart. Pp 24, plus map, figure, tables.

USGS Circular 326, Stratigraphic Sections of the Phosphoria Formation in Montana, 1951. By J. A. Peterson, R. F. Gosman and R. W. Swanson. Pp 27, plus map, tables.

USGS Circular 327, Stratigraphic Sections of the Phosphoria Formation in Idaho, 1950-51. By R. A. Smart, R. G. Waring, T. M. Cheney and R. P. Sheldon. Pp 22, plus map, tables.

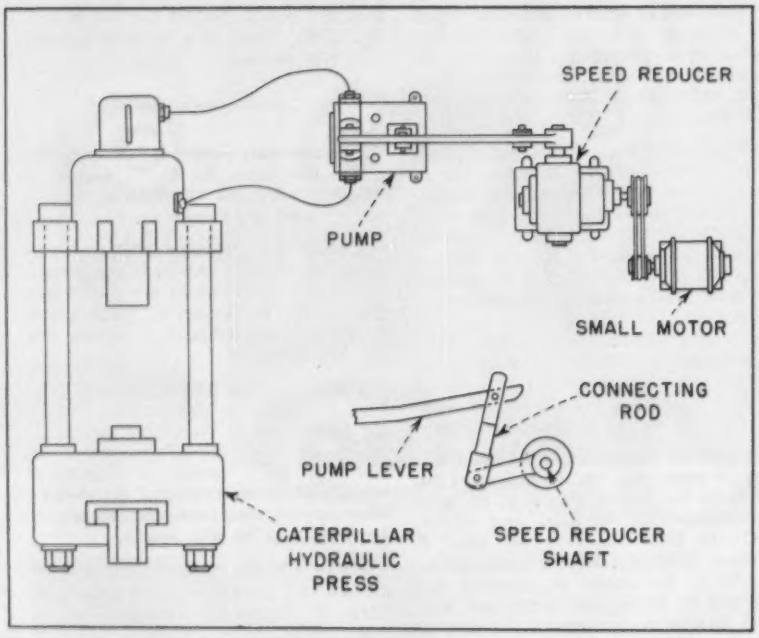
USGS Circular 328, Reconnaissance for Radioactive Deposits in the Lower Yukon-Kuskokwim Region, Alaska, 1952. By Walter S. West. Pp 10, plus maps, and tables.

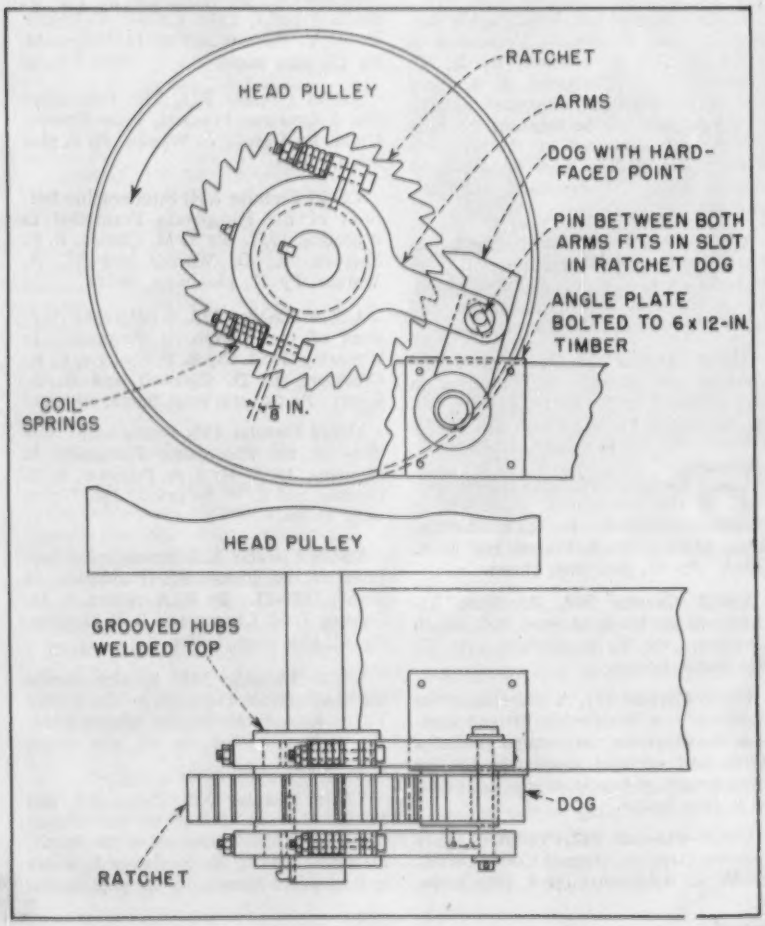
USGS Circular 329, Developed and Potential Water Power of the United States and Other Countries of the World, December 1952. By Benjamin E. Jones and Lloyd L. Young. Pp 12, plus charts.

OPERATING IDEAS

How to Remove Track Pins Quickly

A JOB FREQUENTLY PERFORMED in the repair shop at mines where trackless mining is practiced is the removal of pins from tractor tracks when changing worn track plates. S. E. Rogish, master mechanic, Pend Oreille Mines & Metals Co., Metaline Falls, Wash., offers the simple equipment setup shown to do the job quicker and better. Prior to its adoption this was a two-man operation, with one man operating the pump and another man the press proper. Under the new setup the pump is actuated through a motor-driven speed reducer assembly controlled by push button on the part of the press operator, thereby freeing the pump operator for other work in the shop, in addition to speeding up actual pin removal by about 50%.





Novel Hold-Back For Conveyors

PHIL KEAST, master mechanic, Empire Star Mines Company, Ltd., Grass Valley, Calif., writes that the hold-back unit shown has given satisfactory service on an 18-deg incline belt conveyor 580 ft long. Its chief function is to prevent reversal of the belt conveyor in the event of power failure or sudden kick-out of the starter under load. Simple of design, the device essentially consists of a ratchet 11½ in. in diameter made from 1-in. steel plate, with grooved hubs on each side (welded), keyed on to the head pulley; two bronze-lined steel arms resembling motor connecting rods; steel ratchet dog; and a steel angle plate to secure the pivoted dog to the main stringer supporting the head pulley. Coil springs on the arm bolts provide the tension required on the operating arms to actuate the ratchet dog. Operation is simple. Under normal operation the tension of the arms holds the dog away from the ratchet, while the opposite happens in the event of belt reversal. The tension of the arms then pulls the dog into the ratchet.

BUILT TO BE ABUSED...

It's U. S. Matchless® Wire Braid Air Hose!

This is the hose engineered specifically for hard rock mining, quarrying and tough construction work anywhere in the world—designed by men who *know* what a hose must do.

U.S. Matchless Wire Braid Hose is an all-purpose hose. It can take the highest required working pressures for both air and water, and is built to take the abuse and abrasion encountered in the roughest working conditions. Highly flexible and easy to handle. Never needs cribbing.

Constructed with a Neoprene tube overlaid with high tensile steel wire braid. Top quality brown natural rubber cover. Has extremely high adhesion to carcass.

No matter what your hose requirements are, United States Rubber Company can fill them. Here's where quality pays off—and demonstrates that money is wasted when spent on cheaply-constructed, short-lived hose. Expert "U.S." engineers will aid you in your hose selection and engineering problems. Call any of the 27 "U.S." District Sales Offices.

"U.S." Research perfects it . . . "U.S." Production builds it . . . U.S. Industry depends on it.

UNITED STATES RUBBER COMPANY

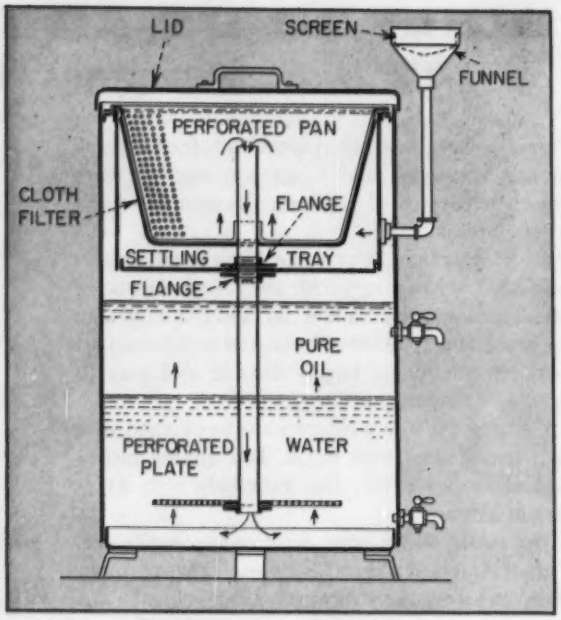
MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

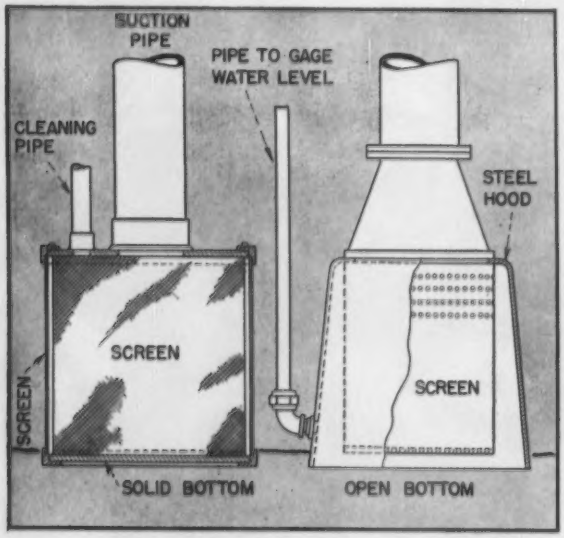
Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes
Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

An Efficient Oil Filter

FILTERING AND PURIFICATION of used oil in general is simple if a practical filter is available at the maintenance and repair shop or mine garage. Such a device can be built without much expense and from scrap material. The simple filter unit shown here has been found effective and satisfactory at several western mines. As illustrated, it consists of a standard oil storage drum with lid; settling tray made from galvanized iron and fitted with a welded-on flange to accommodate the charge funnel assembly; perforated steel pan with filter cloth; and center drain pipe with a perforated steel plate near the bottom end.

Operation is simple. The oil to be filtered is poured through the funnel into the settling tray. In rising, it penetrates the filter cloth and collects in the perforated pan, from which it descends through the central pipe into the bottom of the storage drum partly filled with water. Here, the oil spreads in a thin film over the bottom of the circular plate and rises through the perforations in drops to the surface of the water. In this way the oil is cut up into small particles, each of which is thoroughly washed in its ascent through the water. The purification process will be improved if the water is heated.





Self-Cleaning Strainer

A COMMON PROBLEM facing the maintenance man at the mine or mill is keeping the strainer on a pump's suction pipe clean. A strainer clogged by foreign matter, if not cleaned in time, means reduced pump capacity and ultimate trouble. The operation usually entails shutting down the pump to permit removal of the strainer. Use of the simple unit shown at left will reduce shutdowns to a minimum. Foreign matter adhering to the side screens is removed by water entering the strainer box via the small pipe running from the water supply line to the top of the strainer. All the operator does is open the valve on the cleaner pipe line whenever the vacuum gage on the suction pipe registers a rise in vacuum. The water enters the strainer box under pressure, is deflected by the closed strainer bottom and forced outward through the screens, carrying away any matter collected on them. A flow of one to two minutes is sufficient to clean the screens.

The strainer shown in the right half of the illustration will be found useful on sinker pumps.

The Diesel Itch—How to Prevent It

WIDESPREAD USE OF DIESEL EQUIPMENT in the mining industry warrants a little advice and comment about the "diesel itch", according to Paul C. Ziemke of Oak Ridge, Tenn., who contributes this item. He reports that approximately 10% of the personnel employed in the operation of diesel engines are directly exposed to contact with the radiator fluid containing sodium bichromate. Workers who prepare or transfer the concentrated chromate solution are most likely to become affected with a skin irritation caused by the chromate salt. To a lesser degree those engaged in cleaning, repairing diesel engines may experience skin irritation if they come in contact with the dilute coolant solutions used in the engines.

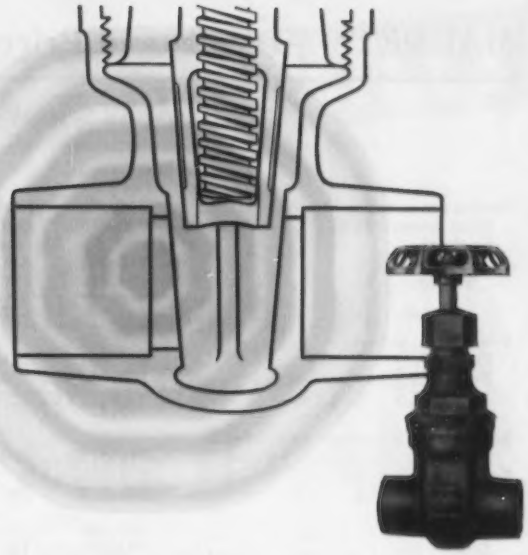
In practice, the cooling solution used in diesel locomotives contains sodium bichromate, soda ash, disodium phosphate and sodium silicate. About 1.5 lb of these powders are dissolved in 2 gal of water to form a concentrated solution. Sodium bichromate concentration is about 6%. This in turn is poured into the diesel radiator plus 210 gal of water to form the dilute solution referred to above.

Here are the measures recommended to prevent the diesel itch: (1) repair all leaky pumps, connections, or engine jackets to avoid leakage of the fluid; (2) use hot water judiciously to clean the engine before starting repairs; (3) protect workmen who come in contact with the concentrated solutions with long-sleeved rubber gloves, rubber aprons, rubber overshoes.

Although the chrome itch may be new to the mining industry, it has long been recognized in the electroplating industry which has devised the necessary precautionary measures to prevent irritation caused by chromate solutions.

When the heat's on

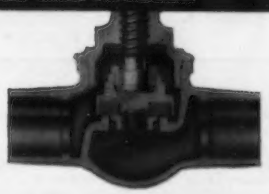
you need the extra strength of JENKINS Solder and Socket End VALVES



Solder End GLOBES and ANGLES

300 lbs. O.W.G.
¼" to 3"

Fitted with Renewable Composition Disc.



Solder End GATES

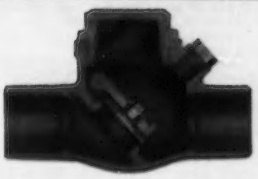
225 lb. and 300 lb. O.W.G.
⅜" to 3"

With solid or split wedges, and stationary or traveling spindles.

Solder End CHECKS

300 lbs. O.W.G.
¼" to 3"

Regrinding. May be easily reground without removal from line.



NEW BULLETIN Lists all Jenkins Solder End and Socket End Valves and gives complete instructions for soldering and brazing. Ask for Solder-Socket End booklet.

The "light-duty" look of copper tubing installations is deceiving. Valves must provide an accurate fit to tubing and *hold it* under the intense heat of soldering. And, because flexible tubing does not afford the rigid support of standard pipe, valves must withstand unusual strains in operation.

Jenkins Solder End Valves are engineered to meet these demands with strength to spare. High tensile bronze castings have liberal dimensions for extra rigidity. Smooth, clean bores assure accurate fit, easy soldering, positive seal to types K, L, and M Copper Tubing.

For faster, trouble-free installation, and lasting economy, specify Jenkins Solder End Valves. Jenkins Bros., 100 Park Ave., New York 17.

JENKINS Socket End Valves

for Class B or IPS Tubing

Jenkins bronze valves with socket ends for silver-brazing are made in Globe, Gate, and Swing Check patterns to control compressed air, hot oil, and similar fluids in tubing hookups where specifications call for permanent, leakproof joints. Complete information in the Bulletin offered below.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros.

SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS

MARKETS—Trends and Prices (Continued from page 69)

U. S. Copper Supply

(Bureau of Mines)
In Short Tons

	1953	1954	January 1954	January 1955
Production primary—				
Mine (recoverable)	926,448	836,251	74,687	82,744
Smelter:				
Domestic	943,391	834,381	77,823	85,910
Foreign	104,419	111,518	11,051	8,268
Total	1,047,810	945,899	88,874	94,178
Production, refinery—				
Domestic	932,232	841,717	71,272	88,312
Foreign	360,885	370,202	24,269	28,841
Total	1,293,117	1,211,919	95,541	117,153
Secondary—Recovered as refined by primary and secondary plants	212,745	205,979	16,611	17,327
Imports of refined (a)	274,776	215,047	14,257	(b)
Exports of refined	109,510	215,952	19,510	(b)
Stocks at end:				
Refined	49,000	25,000	61,000	26,100
Blister, etc.	223,000	189,000	217,000	185,000
Consumption:				
New refined (apparent consumption)	1,435,000	1,235,000	78,000	(b)
Total consumption, refined: (actual) (c)	1,494,215	1,251,398	97,044	122,373

(a) Data include copper imported for immediate consumption plus material entering under bond. (b) Not yet available. (c) Includes estimate for chemical plants, foundries, and miscellaneous plants.

Chrome Ore Imports

Imports of chrome ore into the U. S. in 1954, by grades and countries, in long tons:

	Gross Weight	Value
Metallurgical grade:		
Federation of Rhodesia and Nyasaland	218,940	$ 8,076,888
Iran	1,000	41,500
New Caledonia	26,600	1,110,820
Pakistan	8,529	363,965
Philippines	41,713	1,279,484
Sierra Leone	2,693	88,193
Turkey	272,003	11,876,739
Union of So. Africa	97,018	1,670,910
Total	668,496	$24,508,499
Refractory grade:		
Cuba	33,553	828,997
Fed. of Rhodesia & Nyasaland	17,425	416,025
Greece	49	1,300
India	15,049	276,973
Philippines	388,054	5,766,765
U. of So. Africa	15,959	200,562
Total	470,089	$ 7,490,622
Chemical grade:		
U. of So. Africa	173,976	2,113,183
Total all grades	1,312,561	$34,112,304

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments f.o.b. New York unless otherwise stated, tons of 2,000 lb. unless otherwise noted.

MISCELLANEOUS METALS

March 31, 1955

Aluminum ingot, 99 plus percent, lb.			23.2¢
Antimony, spot, lb., less than carload, in cases			31.97¢
In bulk, carload lots, f.o.b. Laredo			28.50¢
Bismuth, ton lots, lbs.			$2.25
Cadmium, commercial sticks, delivered, lb.			$1.70
Calcium, lb., ton lots, 98 percent, cast			$2.05
Chromium, 97 percent grade, lb., contract			$1.18
Cobalt, 9 to 99 percent, per lb.			$2.60
Germanium, lb.			$295.00
Indium, troy oz.			$2.25
Lithium, lb., 98 percent	$11.00	@	$14.00
Nickel, cathodes, lb., f.o.b. Port Colborne (a)			64½¢
Magnesium, 99.8 percent, carloads, lb., producer's plants, Freeport, Texas			28½¢
Palladium, troy oz.	$17	@	$19
Platinum (wholesale lots) troy oz.	$76.00	@	$80.00
Quicksilver, flask of 76 lbs., 25 flasks or more	$320	@	$323
Selenium, 99 plus percent, lb.	(b)$6.00	@	$7.25
Silicon, minimum 97 percent, carloads, lb.			18¢
Tellurium, lb.			$1.75
Thallium, 100 lb. or more, lb.			$12.50
Titanium, 99.3 plus, grade A, max. 3% iron, lb.			(c) $3.95

(a) Includes 11% U. S. duty. (b) Depending on quantity. (c) Effective April 1, 1955.

METALLIC ORES

Beryllium Ore, imported, 10% BeO, per short ton unit	$38.00	@	$40.00
Chrome Ore per long ton, f.o.b. cars Atl. ports, dry:			
44% Cr_2O_3 no ratio	$22.00	@	$23.00
48% Cr_2O_3 3 to 1 ratio	$43.00	@	$46.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:			
Old Range bessemer			$10.50
Mesabi bessemer			$10.25
Mesabi, non-bessemer			$10.10
Lead (Galena), 80 percent, Joplin, Mo., ton			$187.85
Manganese Ore—Per long ton unit of Mn basis 48 percent manganese, nearby positions, subject to premiums and penalties 85 @ 87¢ c.i.f. U. S. ports, duty extra. Long-term contract nominal at 84 @ 86¢ c.i.f. duty extra.			
Molybdenum Ore, 90%, per lb. of Mo f.o.b. mines			$1.05
Columbium-Tantalum, per lb., combined oxides			$3.40
Tungsten Ore, per unit of WO_3:			
Foreign 60 percent, c.i.f. U. S. ports, duty extra	$27.50	@	$28.50
Domestic, scheelite, 60 percent f.o.b. mill			$63.00
Vanadium Ore, per lb. of contained VO_3 f.o.b. mines			31¢
Zinc Ore, Prime, 60 percent concentrate, Joplin, Mo., per ton			$68.00

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb., in bbl. carload lots delivered			5½¢
Cobalt Oxide, 72½% to 73½%, ceramic grade, per lb.	$1.96	@	$1.97½
Copper Sulphate, 100 lb.			$12.25
Germanium Oxide, lb.			$142.00
Molybdic trioxide, technical, per lb. of Mo	$1.24	@	$1.25

ALLOYS

Ferrochrome 65 to 69 percent, per lb. of Cr. contained			24¾¢
Ferromanganese, 74–76%, net ton, seaboard			$190
Ferromolybdenum, 55 to 65 percent Mo. lb. of Mo. contained	$1.49	@	$1.57
Ferrosilicon, 50 percent per lb. of contained Si			12¢
Ferrotungsten, 72 to 82 percent, lb. of W contained			$3.38
Ferrovanadium, per lb. of V delivered	$3.00	@	$3.25
Silicomanganese, Max. 1½ percent carbon, lb. per contracts			11.4¢
Spiegeleisen, per long ton, 19 @ 21% grade			$86.00

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (U. S. funds) ton:			
Crude No. 1	$960	@	$1,500
Crude No. 2	$595	@	$900
Spinning fibers	$321	@	$514
Shingle fibers	$150	@	$200
Paper stock	$109	@	$137
Waste			$77
Shorts	$35	@	$70
Asbestos, f.o.b. Vancouver, B. C. (U. S. funds):			
Spinning fiber, 3-K			$460
Shingle fiber, 4-K			$185
Asbestos, Vermont, f.o.b. Hyde Park:			
Spinning fibers	$279.50	@	$302.00
Shingle stock	$135.00	@	$162.00
Paper stock	$81.50	@	$115.00
Waste, stucco or plaster			$71.40
Refuse or Shorts	$34.00	@	$63.00
Barytes f.o.b. cars:			
Georgia, crude, per ton			$15.00
Missouri, 94 percent $BaSO_4$, per short ton			$13.25
Bauxite, long ton, f.o.b. point of shipment:			
Domestic crude, 50 to 52 percent (not dried)	(a) $5.00	@	$5.50
Domestic, chemical, 55 to 58 percent	(a) $8.50	@	$9.05
Domestic, abrasive, 80 to 84 percent	(a) $18.00	@	$18.50
Feldspar, bulk ton:			
Potash or soda feldspar, 200 mesh, ceramic grade	$18.50	@	$22.25
Glass feldspar, white, 20 mesh	$11.75	@	$12.50
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$29.00	@	$30.00
60% effective CaF_2	$26.00	@	$27.00
Acid 97% concentrate, bulk, ton			$47.50
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00	@	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington			$38.00
Mica—Domestic, f.o.b. mines. Punch 12 to 22¢ per lb. according to size and quality. Sheet clear, 1½ x 2 inch, 70¢ to 85¢; 2 x 2 inch, $1.10 to $160; 2 x 3 inch, $1.50 @ $1.60; 3 x 3 inch, $1.80 @ $1.90; 3 x 4 inch, $2.20; 3 x 5 inch, $2.40; 4 x 6 inch, $3.15; 6 x 8 inch, $4.25. Wet, ground, very fine, $140 @ $155 per ton. Bulk sales, dry ground: $32.50 @ $70.00 per ton. Scrap $25 and up.			
Ocher, Georgia, ton, in sacks	$26.50	@	$30.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports			Not quoted
Sulphur, Texas, mines, long ton	$25.50	@	$27.50
Talc, f.o.b. works, ton			
New York, purified	$18.50	@	$20.00
Vermont, extra white			$13.50
Tripoli, Missouri, ton:			
40-mesh, cream colored			$30.00

(a) Normal. (b) Effective Oct. 1.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces			$56.00
Steel f.o.b. Pittsburgh, billets, net ton			$64.00
Structural shapes, Pa., Ala. etc., 100 lb.			$4.25

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See what Mr. Neal McMullen, manager of Frank M. Sheesley Co. reports on KVS Rod Mills:

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Selecting the right conveyor belt to solve a special problem begins with selecting the right representative . . . one who will take interest in your particular belt needs and refer your problems to his factory if engineering help is required. Where a company makes a wide selection of conveyor belts for many applications, the representative can often recommend a feature construction to meet your job requirements. Where your problem is unique, that company backs its field men with custom engineering and comes up with a recommendation to meet your specific operating conditions.

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A leading steel mill, faced with handling hot sintered ore without an insulating layer of "fines", had numerous belt failures due to charring.

An R/M representative called in a factory engineer. A new custom-engineered R/M conveyor belt with special cover now saves hundreds of dollars a year at the mill.

and . . . where hot ash and clinker was wearing out a conveyor belt every month at a Michigan cement plant, an R/M field man was able to furnish a specially engineered Homocord Belt which has outlived the best previous belt four times over.

and . . . special, "chevron cleated" conveyor belt was developed by R/M, as a result of a field representative request, to replace a smooth surfaced belt unable to carry wet iron ore up a mine slope without costly spillage.

These are just a few of many instances where R/M engineering service has solved conveyor belt problems. In other cases, special job requirements have been met with R/M's exclusive constructions such as extra-flexible Ray-Man "F" . . . extra-cushioned Homocord for shock-loading . . . and Ray-Man Tension-Master for extra-high tensions and long lifts.

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FINANCIAL AID TO HIGHER EDUCATION

Our Colleges and Universities Are Living on Borrowed Time

. . . time borrowed from underpaid faculty members

The chart on this page tells a story of profound importance to every American. It is the story of the financial beating our college and university faculty members have been taking in the past 14 war and postwar years.

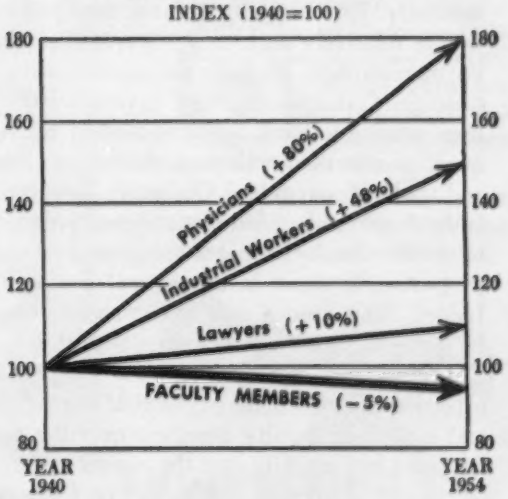
On the whole, this span of 14 years has been one of great and growing prosperity. But, as the chart shows, our college and university faculty members have, as a group, had less than no share in it.

During this period, from 1940 through 1954, the real income of the average industrial worker (that is, what his wages would purchase in goods and services) has increased by almost one-half. Among professional groups, physicians have enjoyed an increase of about 80 per cent in their real income. Lawyers, far less favored financially, have had an increase of about 10 per cent. But faculty members have not only had no increase at all; over these years of prosperity their average real income has fallen by 5 per cent. These figures do not take account of the increase in taxes since 1940.

Senior Teachers Hardest Hit

These figures are, of course, averages. For some groups of faculty members it has been better; for others worse. It has been particularly hard on senior faculty members. Between 1941 and 1953 their salaries lost about 8 per cent of their purchasing power. Being deeply committed to their careers they could not respond to alternative employment opportunities as readily as could their junior colleagues. For junior faculty members there was some increase in real income between 1941 and 1953 but only about half as much as the average for the nation.

What's Happened to College Faculty Salaries*



* Real Income before Taxes

Source: Council for Financial Aid to Education; U. S. Dep't of Commerce; U. S. Dep't of Labor

Public Colleges Fare Better

There are also marked differences in the average financial reward received by faculty members in different types of colleges and universities. A recent study by the Council for Financial Aid to Education indicates that, in the last academic year, 1953-1954, teachers in privately endowed, independent colleges and universities were paid an average salary about $1000 less than that paid to faculty members in tax-supported institutions. The same study indicates that salaries far below the average are especially common for faculty members in the small private liberal arts colleges. This study found that during the last academic year the average salary of all college and university faculty members was about $4700.

The special difficulties under which the independent colleges and universities, and particularly the independent liberal arts colleges, are laboring to get back on their feet financially have been discussed in previous editorials in this series. These difficulties underline the need of special help for these institutions to which business firms are now contributing in increasing volume. However, the problem of providing better salaries is not peculiar to any particular type of institution.

Faculty Members Not Greedy

It is not easy to prescribe a precise standard of fair pay for college and university faculty members. This is partly because they put less weight relatively on money rewards than they put on rewards of scholarly accomplishment and prestige. Consequently, they have consistently been willing to work for very modest salaries in relation to the intellectual ability, education and application required. Obviously, however, it is the dictate both of fairness and good judgment to see that faculty members are given a roughly proportionate share in the general prosperity. Indeed, their crucial role in our society could be made to justify a larger share than this.

There is no way to know with any degree of precision what the underpayment of our college and university faculty members over the past 14 years has actually cost the nation in terms of reduced quality of intellectual performance of those institutions. One reason is that the damage has been minimized by the devoted services of many faculty members who have loyally stuck to their jobs in spite of the great financial discouragement.

It is obvious, however, that, if no grave deterioration in the intellectual performance of our colleges and universities has occurred so far, it is because we have been living on borrowed time. It is time borrowed from faculty members who have, in effect, been subsidizing these institutions by their financial sacrifice. This arrangement is not only a menace to the cultural and intellectual life of the nation, it is also a menace to our national security in a time when successful national survival may well depend in peculiar degree on the full development and utilization of our intellectual resources. We depend on our college and university faculties pre-eminently to provide this development. Adequate financial reward for such service is an elementary form of national insurance.

Many of our colleges and universities are working hard to improve the financial lot of their faculty members. Business firms are also playing an increasing role of providing the necessary financial assistance. The methods being used by business for this purpose will be the subject of another editorial in this series. However, **vastly more must be done, and quickly, to stop the financial beating being taken by our college and university faculty members if the nation's welfare and safety are to be properly protected.**

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

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17,435,250 yards

Only 4 Page Automatic Buckets needed to excavate this enormous yardage of slate, blasted rock, and earth overburden. The Peterson Coal Company, Deerfield, Ohio, moved this material since 1942 with a Page Model 618 Walking Dragline and 5 cu. yd. buckets. The two buckets shown in the photo, and one other, are worn beyond economical repair but the Model 618 and the bucket on it are still in good condition.

"That's what we call good service," says Mr. Clyde Peterson, "so when we needed more coal than the 618 could uncover, we bought the Model 721 Page Walker shown in the picture. With a 7 cu. yd. bucket and 125 foot boom it's just what we wanted. Fast, economical, and easy to operate; and the new Page horizontal V-6 Diesel engine has plenty of power for even the heaviest load."

Page Automatic Buckets are noted for their digging ability. Write for bulletin GPB454 for details.

Page

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AUTOMATIC DRAGLINE BUCKETS
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PERSONAL NEWS

Carl J. Coash (left) has been named publisher of *Engineering & Mining Journal, Coal Age,* and affiliated mining publications, effective April 1. He succeeds **Alfred M. Staehle** (right), publisher for the past 12 years, who asked to be relieved of the mining papers so as to devote his full time to his duties as publisher of *Factory Management & Maintenance,* another McGraw-Hill publication. Mr. Coash first joined McGraw-Hill in 1944 as district manager in the St. Louis area for the mining papers and *Factory.* In January 1947, he became Chicago district manager for the mining publications and since April 1953, has served as advertising sales manager of *E&MJ, Coal Age* and affiliates, with headquarters in New York. Following graduation from the University of Illinois in 1928, Mr. Coash served the State of Illinois as an inspector of engineering and highway construction. Later he joined the F. W. Dodge Corp. and was St. Louis manager of that firm's Sweet's Catalog Div. for 5 years before coming to McGraw-Hill. One of McGraw-Hill's senior publishing executives, Mr. Staehle was graduated from Carnegie Institute of Technology in 1917. Following 6 yr with Westinghouse Electric Corp., he joined McGraw-Hill in 1926 and held various posts on publications specializing in the mining and construction fields before his appointment as manager of *Factory* in 1933. He was assigned the additional responsibilities as publisher of the mining publications in 1942. As publisher of *E&MJ,* with over-all responsibility for editorial and advertising operations, Mr. Staehle has taken active interest in mining problems.

M. S. Fotheringham, president, Steep Rock Iron Mines, Ltd., has been named executive councillor, mining division, Association of Professional Engineers of Canada.

Rare Metals Corp., subsidiary of El Paso Natural Gas Co., has established a northwest and southwest uranium division. **E. J. Carlson** will head the northwest division and **A. A. McKinney** will head the southwest division.

D. F. Rice has been named supervisor of research administration, Consolidated Mining & Smeltering Co. of Canada, Ltd. He joined the company in 1935.

R. J. Henry has been named vice president in charge of operations, and director, Eldorado Mining & Refining Ltd.

D. Melong has been named superintendent of milling operations, Wright-Hargreaves Mines Ltd., Kirkland Lake, Ont., Canada, succeeding the late **Malcolm Black.**

Donald F. Pease, Pittsburgh, has been named assistant vice president, industrial relations, U. S. Steep Corp.

Luis A. Nogales, manager of production, Bolivian Mining Corp., has resigned to become a consulting mining engineer in La Paz, Bolivia.

John F. Dugan, general superintendent of mines, International Smelting & Refining Co., has retired, but will continue as consultant.

Hugh Wright has been named executive secretary, Tri-State Zinc and Lead Ore Producers Association, Picher, Okla.

Henry P. Early, chief engineer, Magna mill's central power plant, Utah Copper Div., Kennecott Copper Corp., retired Dec. 1. He is succeeded by **John H. Harkins,** assistant chief engineer.

Herbert M. Leppich has been named director, division of engineering and construction, Idaho operations, Atomic Energy Commission.

Joseph C. Schumacher, vice president and director of research, Western Electrochemical Co., has joined American Potash & Chemical Corp. as director of research.

Dooley P. Wheeler Jr., superintendent, Western exploration, American Metal Co., Ltd., has resigned to enter business in Salt Lake City as private consultant on mining geology.

H. W. North, Pittsburgh, has recently been appointed chief engineer of the newly-established process equipment department, Dravo Corp.'s engineering works division.

Sidney S. Goodwin has been named a director, and **Lindsay F. Johnson,** vice president, New Jersey Zinc Co. Mr. Goodwin is vice president in charge of mining and exploration and has been with the company 24 yr. Mr. Johnson, with the company 13 yr, has been assistant to the president since 1954.

Robert G. Schmidt, U. S. Geological Survey, stationed at Crosby, Minn. on the Cuyuna Iron Range since 1951, has been transferred to the Washington, D. C. offices of the Survey.

John E. Frost has left American Smelting and Refining Co., Salt Lake City, to accept the position of chief geologist, Philippine Iron Mines, Inc., Philippine Islands.

S. A. Huffman has been named superintendent of mechanical maintenance, Reserve Mining Co., Duluth, Minn.

Myron L. Trilsch has been named manager of the Los Angeles office, American Metal Co., Ltd. of California, a new subsidiary of American Metal Co., Ltd.

Cerro de Pasco has announced the following appointments: **J. W. Hanley,** coordinator, zinc program, Oroya; **J. W. Semmens,** mine superintendent, San Cristobal; **P. J. Hickey,** superintendent, lead and copper refining, Oroya; **F. D. Ostojic,** superintendent, Casapalca concentrator; **H. W. Higgs,** metallurgical assistant to the manager of operations, Oroya; **G. A. Davison,** mine superintendent, Cuajone; **P. H. Cadiot,** superintendent, Morococha concentrator; **D. A. Ricketts,** assistant general superintendent of smelting and refining; **Peter J. Muysken,** superintendent, Mahr concentrator; and **David Oxley,** mechanical superintendent, concentrators.

Owen Richards has joined the staff of Carpco Research and Engineering Co. in Jacksonville, Fla.

John A Reeves, chief engineer, Independent Coal & Coke Co., Salt Lake City, Utah, has resigned to accept the post of mining engineer, Monsanto Chemical Co., Soda Springs, Idaho.

At the annual meeting of the Minnesota Section, American Institute of Min-

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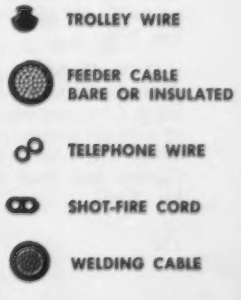

ing and Metallurgical Engineers held Jan. 10 at Duluth, Minn., the following officers were elected: **Milton F. Williams,** chairman; **Clarence H. Sleeman,** first vice chairman; **Earl C. Herkenhoff,** second vice chairman; **A. W. Kangas,** third vice chairman; and **Henry H. Wade,** secretary-treasurer.

Harlan G. Bower, member of the New Mexico Western College faculty, will edit a new employee publication at Kennecott Copper Corp.'s Chino Mines division in Santa Rita and Hurley, N. M.

Ben Kangas has been reappointed mine inspector for St. Louis County, Minn., for a 3-yr term.

James D. Warner, mine captain, Sibley iron mine, has been named operating engineer, Ely mines, Oliver Iron Mining division, U. S. Steel Corp., on the Vermillion Iron Range.

William Bianchi, associated with Mather iron mine, has resigned to accept the post of mine captain, Penokee iron mine, North Range Mining Co., Ironwood, Mich. **Clarence Goldsworth,** surface foreman, Champion iron mine, has been transferred to Penokee iron mine as surface foreman.

F. M. Hamilton, supervisor of agglomeration research, has been named to a similar post at Jones & Laughlin Steel Corp.'s New York ore division, Star Lake, N. Y.

Dr. W. H. White of the department of geology, University of British Columbia, has been elected chairman of the British Columbia Section, Canadian Institute of Mining and Metallurgy. First and second vice presidents are **T. M. Waterland,** assistant manager, Britannia Mines; and **U. S. Annett,** manager, explosives division, Canadian Industries Ltd. **H. C. Hughes** was named vice president representing District No. 6 including British Columbia and Yukon. **Arthur O. Hall,** resident manager, American Smelting and Refining Co., for B. C., Yukon and Alaska, was named chairman of the Vancouver Branch, succeeding **Maj. Gen. J. P. Mackenzie. Robert B. King,** resident engineer, B. C. department of mines was named first vice chairman; and **Ridgeway W. Wilson,** managing director, Silver Standard Mines Ltd., was named second vice chairman. **Fred H. Stephens** was re-elected secretary-treasurer.

William H. Kinney has been named resident metallurgical engineer, Kaiser Steel Corp., Oakland, Calif. He joined the company in 1948.

James Wade, superintendent of construction, for the state of Utah, has resigned to become general superintendent of the Lucky Mc Uranium Corp., Riverton, Wyo.

C. Y. Garber, superintendent, milling department, Bunker Hill & Sullivan Mining & Concentrating Co., retired after 36 yr with the company. **Alvin F. Kroll,** assistant mill superintendent, succeeds Mr. Garber, and **Fred L. Prindle** succeeds Mr. Kroll.

M. S. Gokhale, manager, mechanical standards, RCA victor division, Radio Corp. of America, has been named president, Standards Engineers Society, for 1955. **Herbert G. Arlt,** materials specification engineer, Bell Telephone Laboratories is vice president. Other officers named are: **Victor S. Gittens,** Philco Corp., treasurer; and **C. W. Bowler,** Leeds & Northrup Co., secretary.

Ted Becker, chief mining engineer, American Zinc, Lead and Smelting Co., Grandview mine, has joined the Loma Uranium Corp. of Denver, Colo. as geologist and mining engineer.

F. E. Boren, fire chief of Silver City, N. M., for the last 10 yr, has been named fire marshal at the New Mexico operations of Kennecott Copper Corp.

Lt. Col. A. A. Anderson, B.Sc., P. Eng., has retired as chief engineer, Harbours and Rivers Engineering Branch, Canadian Department of Public Works. **Brig. Jean-Paul Carriere,** P. Eng., succeeds Lt. Col. Anderson.

Roy C. Hobson has been promoted to manager, Chicago plant, National Malleable and Steel Castings Co., and **Allan S. Bixby,** has been named manager, Melrose park plant.

Charles Mitchell, secretary, Mining Association of British Columbia, has resigned to undertake a 3-yr job organizing the British Empire Mining Conference, to be held in Vancouver in 1957.

J. D. Hartley has been promoted to superintendent, Consolidated Mining and Smelting Co.'s zinc department at Trail, B. C., Canada. He had been assistant superintendent of the department since June 1954.

M. M. Hardin, Albuquerque, N. M., has been named a director of Kennecott Copper Corp.

John C. Best, vice president, National Gypsum Co., Buffalo, N. Y., retired Feb. 28. Joining the company as vice president, Industrial division in 1938, he served as president of the Gypsum Association during World War II.

Roland D. Parks, Assoc. Prof. of Mineral Industry, Massachusetts Institute of Technology, is on a year's leave of absence as guest professor at the Indian School of Mines and Applied Geology, Dhanbad, Bikar, India, sponsored by U. S. Foreign Operations Administration.

Joseph B. Erni has formed a corporation with **John C. Haddock,** located in Grand Junction, Colo. Called Ernie & Co., Inc., it is currently operating uranium, silver and gold mines in the Colorado Plateau. Officers of the new company are: Mr. Erni, president; Mr. Haddock, vice president and treasurer; **Harry P. Cherigos,** vice president and **C. H. Searles,** secretary.

Charles H. Segerstrom Jr., president, Nevada-Massachusetts Co. at Tungsten, was elected to the board of directors, Nevada Mining Association, Inc., at the

(Continued on p 182)

OBITUARIES

Elton Hoyt 2d, 66, senior partner of Pickands, Mather & Co. since 1940, died March 16 at University Hospital, Cleveland, Ohio. He was also president of Erie Mining Co. and Mather Iron Co., and a director of Stewart Mining Co.

David E. Grove, 88, president, Ymir-Commodore Mines, Inc., Ymir, B. C., Canada, died recently in Spokane, Wash., after an extended illness.

John J. Cadot, 65, executive vice president, Hardinge Co., Inc., York, Pa., died Jan. 19 following a lung operation.

Daniel W. Butner, 64, northwest chief, U. S. Bureau of Mines, died recently in a Spokane, Wash., hospital following a stroke.

Theodore J. Hoover, 84, elder brother of former President Herbert Hoover, died Feb. 4, at his ranch north of Santa Cruz, Calif. Mr. Hoover retired in 1936 as dean of the Stanford University School of Engineering.

Verner A. Gilles, 68, chief geologist, Northern Pacific Railway Co. until his retirement in May 1954, died Nov. 9.

Raymond E. Fernstrom, 44, associated with mines in California, Arizona, Washington and the Philippines since 1930, died Dec. 14 in Tucson, Ariz.

James A. MacKillican, 73, mining engineer on the Mesabi Iron Range in Minnesota for most of his career, died Feb. 6 at Lake Wales, Fla.

Ogden A. Kantner, 43, president, United Clay Mines Corp., Trenton, N. J., died Oct. 10.

Oscar C. Wills, 69, vice president, Union Manganese Co., Marion, Va., was killed Sept. 28 in an accident at Union Manganese mine, near Marion.

Manfred McGeer, 61, died Jan. 22 at Vancouver, B. C., Canada. An active figure in the mining industry, he was instrumental in the sale of important mines and in interesting capital in the development of the industry.

Ronald H. Grace, 51, secretary-treasurer and director, Bralorne Mines, Ltd., died February 5 at Harrisburg, Pa.

John E. Spear, president and managing director, Western Gypsum Products, Ltd., died at Winnipeg, Jan. 12.

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MODERN PROSPECTORS now search for new mineral deposits first with the airborne magnetometer in conventional aircraft, flying 500 feet above the terrain. Then, when the target area has been marked out, they move in for detailed studies with the helicopter-borne magnetometer. These close range surveys, covering the terrain at treetop height, replace the slow, foot-slogging ground studies which used to follow the first air survey. Unhindered by brush, jungle or muskeg, these helicopter surveys quickly provide a final, continuous record that's more significant and less costly than ground studies.*

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E. D. Gardner is presented the Daniel C. Jackling Award by Tell Ertl, as incoming AIMMPE president, H. DeWitt Smith looks on.

Medals and Honors

Edwin Letts Oliver . . . The James Douglas Medal
George Herman Deike Sr. . . . The Erskine Ramsay Medal
Stewart J. Cort . . . The Benjamin F. Fairless Award
F. W. Boulger and R. H. Frazier . . . The Robert W. Hunt Award
Gust Bitsianes . . . The J. E. Johnson Jr. Award
Harold Vagtborg Jr. . . . The Rossiter W. Raymond Memorial Award
W. G. Pfann . . . The Mathewson Gold Medal
Edward W. Davis . . . The Robert H. Richards Award
R. E. Thurmond, W. E. Heinrichs Jr., E. D. Spaulding . . . The Robert Peele Award
Edward D Gardner . . . The Jackling Award
C. S. Roberts . . . The Alfred Noble Prize
Arthur C. Schaufler . . . The William E. Brewster Scholarship

AIME Gets a New Name at Chicago

ONE OF THE FIRST MOVES made by the AIME Board of Directors at the Institute's annual meeting in Chicago in February, was the changing of the name by which the organization has been known for lo these 84 years. Henceforth the official designation is American Institute of Mining, Metallurgical and Petroleum Engineers. With petroleum engineers making up 28% of the 22,500 professional and 2,000 student associate members, such recognition is certainly due. What's more, it has been mentioned that if new membership trends of the past few years continue, the proportion of petroleum men in the institute will become even greater.

Other important business conducted was the election of Carl E. Reistle Jr., vice president of Humble Oil and Refining Co., as president-elect.

At the annual banquet, an event featured by thoughtfully concise speeches, the Institute's annual awards were made by out-going president Leo F. Reinartz, who then turned the gavel over to H. DeWitt Smith, the new president.

Earlier during the meeting, at the Mining Branch luncheon, incoming President Smith had rung the bell with a frank talk about the mining industry's need to attract young engineering talent. In as forthright a talk as we have heard on the subject, he advocated better pay, more attention to improving housing and other amenities, and in general, a better public relations job by the whole industry.

It was at this gathering that Edward D. Gardner, chief mining engineer, U. S. Bureau of Mines, was presented the Jackling award by Prof. Tell Ertl of Ohio State University. For those who like to see loose ends tied up, we are pleased to report that Reno Sales, recipient of the Jackling award in New York, last year, finally received the actual plaque.

At another luncheon, that of the Industrial Minerals Division, a capacity crowd heard David E. Lillienthal outline the threatened water supply crisis, a problem he considers more urgent than the atoms-for-peace program. "We expect to have 60 million more people in this country in 20 years," he stated, "But we can't stockpile water and there's no present indication that we'll have any increased water supply then." Referring to the cold war as justification for an expensive program to develop atomic electrical power, Mr. Lillienthal asked the provocative question, "What would be a greater cold war weapon in arid, over-populated India—more electricity or a great increase in water for farming?"

Technical Sessions

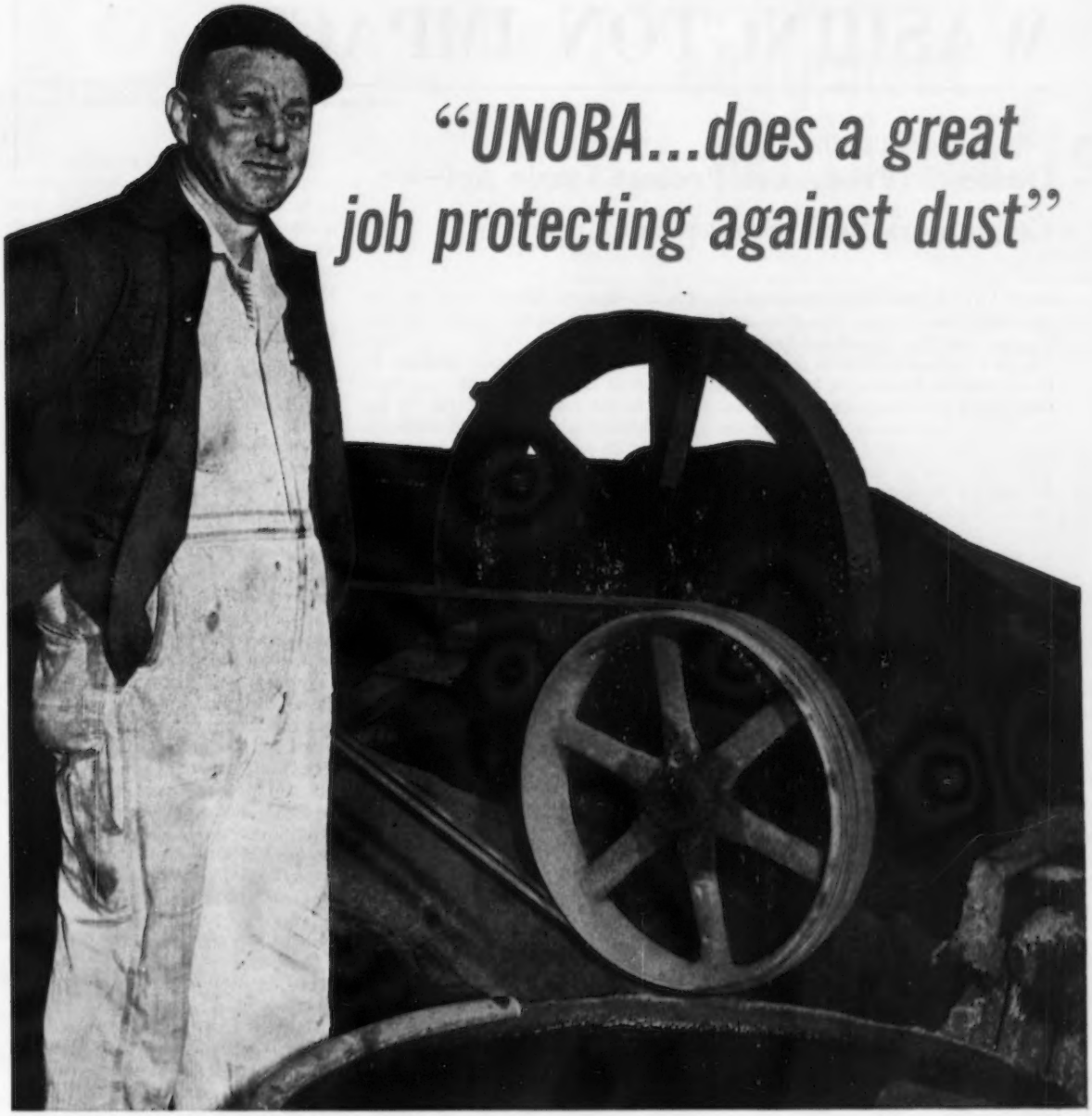
Over 2,500 minerals industry men (the ladies brought registration to 2,951) checked into Chicago for the meeting, making it the largest ever held outside of New York. There was bound to be something for everybody among the 264 papers given. Squeezed into 4 days, the 65 technical sessions running sometimes 5 and 6 at once, required that reporters spread themselves pretty thin. Buttonholing competent meeting-goers revealed a fairly uniform distribution of interest. Sessions that might be cited for playing to near SRO audiences were:

Uranium: Merritt Ruddock, vice president of Cal-Uranium Co., noted in discussing trends on the Colorado Plateau, that uranium companies are getting away from the days when they seemed to "have been more interested in mining the public investor than in mining ore." On the same program, Thomas N. Walthier, senior geologist with Bear Creak Mining Co., covered potential commercial uranium deposits east of the Mississippi.

Hydrometallurgy: There never was a lack of audience at sessions on "Hydrometallurgy; Solution and Precipitation," and discussion was widespread. Particular attention was given to F. A. Schauffelberger's paper "Nickel-Cobalt Separation by Selective Reduction." Mr. Schauffelberger is on the staff of Chemical Construction Corp., and the word was that this process is the one that will be used by Freeport Sulphur Co. in handling Moa Bay ores.

Crushing and Grinding: As always, interest was rabid here. Among the new ideas presented was Prof. Arbiter's (Columbia University), "Power Correlation for Rod Mills."

"UNOBA...does a great job protecting against dust"



R. V. Hamilton, general superintendent, Trout Mining Div., American Machine & Metals, Philipsburg, Montana.

"Extreme dust conditions characterize our operation, the production of grade A battery manganese.

"The abrasive effects of manganese dust on machinery can be a real problem. However, we have successfully solved this one by lubricating with Union's UNOBA F-1. No other grease I know of does such a great job of protecting bearings and other moving parts against dust abrasion. And we can use this same grease everywhere in the mill, even where heat, moisture and acid conditions prevail.

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If dust is a problem in your operation we suggest that you do as Mr. Hamilton did. Call on your nearby Union Oil representative for UNOBA, the *multipurpose* grease.

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WASHINGTON IMPACT

McGraw-Hill Washington News Bureau

Domestic Producers Protest Trade Act—Consumers Seek Stockpile Copper

HOWARD I. YOUNG, president of the American Mining Congress and the American Zinc, Lead and Smelting Co., in a statement made to the Senate Committee on Finance, in March, recommended that Congress let the present Trade Agreements Act expire on June 12. He also said if Congress extends the law it should arrange to transfer to itself from the President the authority to act on escape clause and "peril point" recommendations of the Tariff Commission.

He cited the Tariff Commission's unanimous findings last year that tariff duties be increased on lead and zinc imports and their subsequent disregard by the President as an example of the need for returning tariff authority to Congress. He said the President, instead of accepting the Tariff Commission findings, ordered adoption of an expanded stockpiling program embracing purchases of lead and zinc as a means of bringing relief to the domestic industry.

Reduction of duties on strategic and critical minerals have proved serious deterrents to domestic mine production, according to Mr. Young. He told the Committee "the myth that low tariffs and higher imports of metals and minerals are beneficial to the consuming industries of this country utterly fails to recognize the facts, and it is my firm conviction that reasonable tariffs to protect at least a mobilization base in the metals and minerals industry is in our national self-interest."

Otto Herres, president of Utah Mining Association, told the Committee that the President did not heed recommendations of the Tariff Commission for relief from imports under the escape clause of the Trade Agreements Act, but established stockpiling of lead and zinc as a substitute measure. This, Mr. Herres asserted, "is not accomplishing its intended purpose."

Tom Kiser, representing the Tri-State lead-zinc district, said that there are now 2,000 unemployed miners in the area, and that working miners are accepting lower pay to keep additional mines from shutting down.

Miles Romney, manager of the Utah Mining Association, summarized his testimony by requesting an "excise tax on imports when prices in our domestic markets are below an economic level."

Late in March Senator Wallace F. Bennett of Utah introduced an amendment in the foreign trade bill of the Administration which would impose a tariff of 2c a pound when the price of zinc fell below 13c, and the lead price below 15c.

Senator Joseph C. O'Mahoney, of Wyoming, took the position that reciprocal trade agreements negotiated under the Trade Agreements Act should be made subject to Congressional approval. The present system of negotiating constitutes "the gateway to authoritarian government," he said.

Copper Shortage Distresses Brass Industry

Late in March the Brass Mill Advisory Committee met with Government agencies including Business and Defense Services Administration and the U. S. Department of Commerce to request assistance to relieve a critical copper shortage in the industry which curtailed mill output as much as 25 to 35%. The advisory committee made the following recommendations:

1. Second quarter 1955 export quotas for copper and copper base alloys scrap be cut at least 50%.

2. That for the duration of the acute shortage a complete embargo be placed on exports of domestic copper and copper base alloys, and that the present embargo on refined copper of domestic origin be continued.

3. That authority be given to divert all Government-owned copper produced under Defense Production Act contracts from stockpile to the industry for the duration of the emergency.

4. That replacement of copper previously diverted from Government account due to be made by June 30 be deferred.

5. That copper be taken immediately from Government stockpile over and above amounts already diverted or withdrawn, in amounts sufficient to make up an estimated deficiency of 42,000 tons for the period up to and including May.

At this meeting and previous discussions among copper industry people, opinion has been expressed that large quantities of copper are finding their way behind the Iron Curtain and aggravating the critical shortage in the U. S. and Eastern Europe.

Regulations Prepared for Multiple Mineral Act

The Interior Secy. McKay will put regulations for the Multiple Mineral Development Act of 1954 into effect sometime in May. These new rules are ready to be signed, and will become effective after a 30-day suggestion period, closing April 7.

The new act, which permits leasing and claims on the same land, to which the Federal Government retains mineral rights, was rushed through Congress as a result of the uranium development on the Colorado Plateau.

Previously, Federal mineral lands staked for gold, silver, or other hard minerals, could not simultaneously be leased for gas or oil drilling. The reverse was also true. Uranium prospectors found they were unable legally to obtain bonus payments from the government on lands already leased for oil rights due to the conflict between the Mineral Leasing Act and the General Mining Act. The new law will open a potential of 60 million acres to simultaneous development.

Provisions of the Interior Department's regulations follow the act fairly closely.

Under the new regulations, mineral leasing applicants are authorized to publish notices requiring mining claimants to reveal interests which may be adverse to lessees. Public hearings would follow evidence of conflicts. Mining for fissionable source materials is clearly specified in the regulations, removing the necessity of a clause in all patents and leases reserving fissionable materials to the Federal Government. Such reservation is now automatically provided for by the New Atomic Energy Act and the Multiple Mineral Development Act. The establishment of multiple-mineral development on the same tract is systematized in the regulations, permitting leasing or staking on prior staked or leased claims.

House Passes H.R.100

H. R. 100, the Mining Claims Rights Restoration Act of 1955, just passed

NATIONAL equipment cuts per-ton costs

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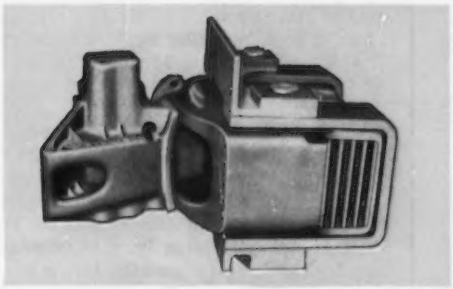
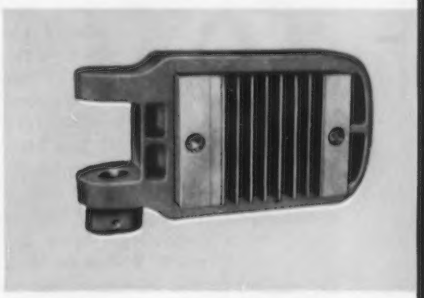
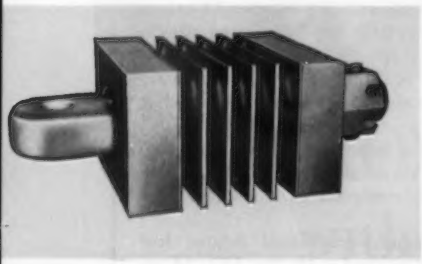
WILLISON AUTOMATIC COUPLERS save time with maximum safety, couple at either end of car or locomotive, require no manual assistance, eliminate damaging slack, permit high speeds with maximum stability.



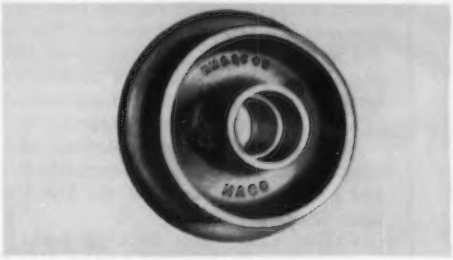
NATIONAL MI-235 Rubber-Cushioned Draft Gear primarily used in Willison spherical-horn coupler assemblies for drop-bottom cars and locomotives; are effective with link and pin bumpers and in strap yokes.



NATIONAL MI-225 Rubber-Cushioned Draft Gear for locomotives and large capacity cars not required to operate through rotary dump. Give maximum impact protection in minimum space.



NATIONAL MI-230 Rubber-Cushioned Draft Gear for cars in rotary dump service. High-capacity rubber pads with soft initial action provide maximum impact protection, lengthen equipment life. Available in capacities and designs to fit individual requirements.



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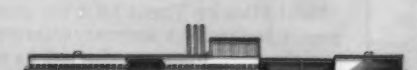

"Progress through Research"

in the House, has been referred to the Mining and Minerals Subcommittee of the Senate Interior and Insular Affairs Committee for early consideration.

Similar bills, passed by the House, have always been killed by the Senate, although this year the bill is conceded a fairly good chance of finally being passed.

The bill would permit mineral removal by private concerns on lands reserved by the Federal Government for power rights. Some seven million acres potentially would be available. The House Bill, H. R. 100, introduced by Rep. Engle (D., Cal.) was passed unanimously. After it was referred to the Senate Subcommittee, Senator Barrett (R., Wyo.), introduced a companion bill, S-1502, which was also referred to the Mining and Minerals Subcommittee. However, introduction of this bill will delay action on the legislation, since S-1502 has been referred to the Interior Department for comment. This may not be completed until April 21. H. R. 100 had previously been commented upon by the department, when it was under consideration in the House of Representatives.

The act, as proposed in S-1502 and H. R. 100, would not affect present mineral claims.

Silver Purchase Laws

Once again New England legislators are pushing for repeal of the Mandatory Silver Purchase Laws.

S-1427, concurrently sponsored by Senators Green (D., R. I.), Bush (R., Conn.), Pastore (D., R. I.), Douglas, (D., Ill.), Kennedy (D., Mass.), Purtell (R., Conn.), and Saltonstall (R., Mass.), has been referred to the Committee on Banking and Currency. Chances for this bill are regarded as slim.

Uranium Stock Investigation

Senator Chavez (D., N. M.) has proposed an investigation of uranium stocks by the Committee on Banking and Currency, Senate Resolution 59, although action on the plan may not begin for another month.

The Chavez proposal calls for a Securities Exchange Commission minimum of $300,000 as a requirement prior to issuance of uranium stocks. The resolution does not call for hearings, and the investigation will probably be carried on by staff members through analysis of the amount of investor-risk involved in speculative stocks offered for certain uranium ventures.

LABOR THIS MONTH

Alan E. Adams, McGraw-Hill Washington News Bureau

MINE-MILL'S GUARANTEED WAGE: Mine owners will face the guaranteed annual wage in 1955 bargaining, if Mine-Mill and Smelter Workers Union follows through on contract goals set at its recent convention. Union officials are talking about bargaining for a contract that would assure members a $60 a week income. It works this way: Management would be required to pay wages making up the difference between part-time wages, or unemployment insurance up to the $60 total.

Mine-Mill's bargaining chief, Orville Larson, calls this "lost time insurance." He says it should be a major demand because workers are security-conscious this year. Besides the wage guarantee, the mine union is planning these proposals for coming negotiations:

- A 20c wage increase. Higher wages are considered the number one goal to make up what the union claims is a loss in take-home pay because of a cut-back in weekly working hours over the past 2 yr.
- Better pensions. Mine-Mill wants to boost retirement benefits to $2.50 a month for each year of service. It is also seeking an earlier retirement age for miners.
- Health and welfare improvements. Union officials cite the Kennecott system as a model to shoot at with its uniform plan for all members in the company system. Specifically, Mine-Mill is promoting a health and welfare plan financed solely by management, with complete coverage for hospital, surgical and doctor costs for employees and dependents.

This is an extensive bargaining package, but Mine-Mill claims the non-ferrous industry can afford it, in part because of the recent increases in metal stock prices. But, it's easier to talk a good bargaining program than it is to achieve it—and Mine-Mill would be content to win just a part of these demands.

LEFT-WING UNIONS STEM TIDE: The onslaught by the Government and right-wing unions on Communist-dominated labor groups has stalled on two fronts:

- The National Labor Relations Board, in the face of Court challenge, backtracked on orders barring both Mine-Mill and the Fur and Leather Workers Union from its services. The Courts held the Board was powerless to act against the unions whose officials are convicted of filing false non-Communist oaths. As a consequence, both unions can once again take part in NLRB-sponsored representation elections and file unfair labor practice charges against employers.

But the Board's penalty actions had one important effect. The two officials under attack—secretary-treasurer Maurice Travis of Mine-Mill and president Ben Gold of the Fur Union—resigned as a result of the Board's move.

- The AFL's fight to keep out Communist-dominated unions lost ground when the Fur and Leather Workers merged with the AFL Meatpacking Union. The affiliation was completed despite opposition by the powerful AFL executive council. It's the first successful attempt by the left-wing unions to hide under the umbrella of the anti-Communist labor federations in hopes of escaping a crackdown by the Federal Government.

But the issue isn't settled yet. The Meatpackers promised the AFL a clean-up of suspect Communist influence in their new affiliate, but if they fail there's a good chance the newly-combined union will be expelled from the "House of Labor."

Mine-Mill also seeks a haven, hoping for the same success the Fur Workers achieved in signing up with the AFL. They're sending out feelers to both the AFL and CIO about possible affiliation—but claim they'll insist on "principles" that assure complete autonomy to the union, and retention of its left-wing leaders. So far, MMSW has gotten the cold shoulder, and it's unlikely either federation will warm up to the idea.

While MMSW officials talk "principles" on merger, it's clear they'd be willing to bargain. This is evident by the decision not to run left-wing official Maurice Travis for a top post in the union's elections next month. Travis resigned as secretary-treasurer in the face of the NLRB penalty and though the Board called off its move, Travis won't return to his post. By this, Mine-Mill hopes to curry favor with right-wing labor groups.

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THIS MONTH IN MINING

E&MJ Special Report:

Second U_3O_8 Find Spurs Spokane Boom

BIGGEST URANIUM STAKING RUSH since last Fall's stampede in Kern County, Calif., is taking place in Stevens and Spokane Counties, Washington.

Large and small Western mining companies had already started staking in the area in and north of the Spokane Indian Reservation, where Midnight Mines has been producing .285% uranium oxide, when high grade autunite was discovered on the farm of Alfred D. Dahl, near Elk.

Dahl's sons, Alfred Jr. and Leonard, found the uranium about 12 years ago while they were digging post holes. The yellow-green ore attracted them and they kept samples. Recently they saw one of the many samples of the Spokane Reservation ore in circulation and then realized they had a similar finding.

A partnership of Spokane oilmen has leased 3,000 acres in the two northeastern counties, including 360 acres of the Dahl farm. Evergreen Uranium Inc. said it will begin developing the property as soon as weather permits. (March brought the heaviest snowfall and coldest reading of the winter in the area.) Evergreen has been organized by Kae Sowers and James W. Fox of Opportunity, a township east of Spokane; Thomas Smith, realtor; Armour Smith and Kenneth Coppock, prospectors; and John F. Campbell, attorney, all of Spokane.

Evergreen lease provides for payment of an undisclosed sum to the Dahls and a royalty on production if the find proves to be of commercial value.

Dr. W. C. Miner, retired Opportunity dentist, also is reported to have found a showing 2½ miles north of the Dahl discovery. He is said to be considering some lease offers.

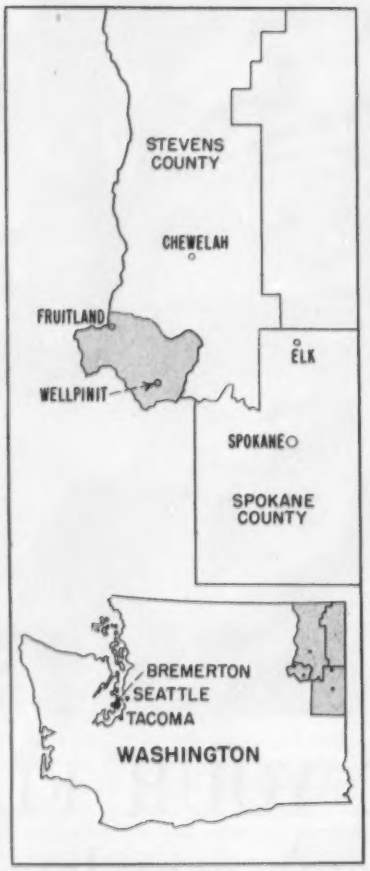
Eskill Anderson, geologist for Grandview Mines, Inc., which holds 2,000 acres near the Indian Reservation, said the Dahl autunite was like that being mined on the reservation.

Midnight Mines, Inc.

First carload from the Spokane Indian Reservation's Midnight Mines was 50 tons shipped to Salt Lake City Dec. 16, 1954. Shipments have continued to Salt Lake City, with average .285% ore, netting the company $44 a ton. Price includes the initial production bonus of about $20 per ton shipped of the first 10,000 lb of contained U_3O_8.

Returns are the average of 600 tons shipped from the mine. During February, 100 tons were shipped, but were halted because of seasonal highway restrictions.

State lands in Stevens County, north of the reservation, have been completely staked out by uranium leasers, says Frank O. Sether, assistant to the Washington State Land Commissioner, and no further state lands are available in the area.



First Uranium Find was on Indian Reservation around Wellpinit. Interest now centers around Elk.

Other mining groups reportedly interested in rush section, with holdings in and around the Indian reservation are:

Phelps Dodge Corp., with a reported 2700 acres of state land north of the reservation, held by a 2-year renewable lease;

Grandview Mines Inc., with 2,000. Surface prospecting will get under way when weather permits;

Bernard Swerland, Spokane attorney, for Robert Boyd and others, four leases on 500 acres adjoining the tribal lands;

Edward G. Bond, Spokane, 28 mining claims;

Wellpinit Uranium Associates, with three claims filed through A. C. Townsend, Spokane;

Berne W. Hackett and Donald E. Gibson, Spokane, three claims;

Alfred L. Ray, Spokane, and associates, who have sent diamond drills over 100 ft into the hillside on their claims trying to intersect veins discovered in surface bulldozing. A 10-ft shaft on one vein has yet to reach commercial ore. Ray holds a total of 19 claims;

Spokane tribe members have applied for prospecting leases over 75,000 acres of tribal land within the reservation.

Tribe has been authorized by the Department of the Interior to lease tribal lands for uranium exploration without advertising for bids. The tribal council had urged granting the authority to permit the tribe to protect and control persons prospecting on Indian lands.

Tungsten Uranium Mines, Inc., has been formed to take over operation of the Germania mine, 4 miles north of Midnight, in Stevens County, from Pentincton Tungsten Mines Ltd., Canadian corporation. V. A. Johnson, Spokane, is president of the new U. S. organization; C. A. Voight is vice president. Frank Eichelberger, Spokane mining engineer, is president of the Canadian firm. Wellman Clark is secretary-treasurer of both.

Johnson has filed two claim locations in Stevens County adjoining the Germania properties on the south; both reportedly show radioactivity. Firm will explore for uranium when weather permits.

Robert B. Coleman, ore buyer for Vitro Uranium Co., reported to John C. and James LeBret, discoverers of Midnight Mines, that their ore is one of the easiest to mill in the U. S.

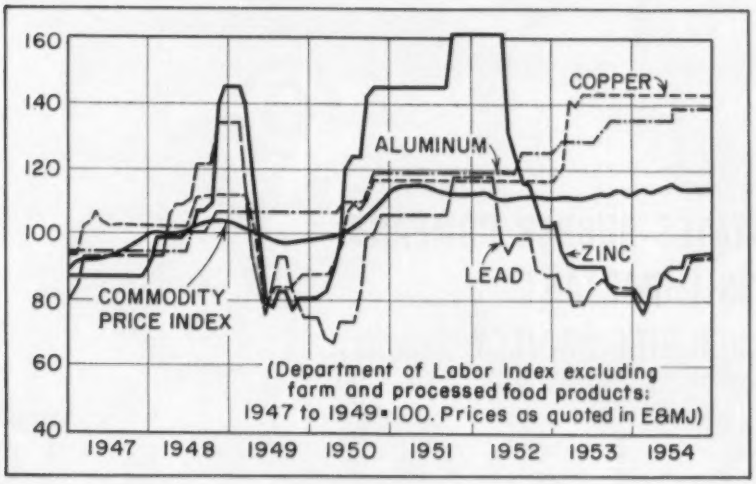
The LeBrets say ore is improving with depth.

If 300,000 tons could be blocked out, Coleman said, Vitro would consider building a uranium processing plant in the vicinity because abundant water and electricity are available, as is sulphuric acid from the Sullivan Mining Co. electrolytic zinc plant near Kellogg, Idaho.

Several companies are reported considering construction of a mill in the area to handle the ore.

AEC Announces Two New Ore-Buying Stations

TWO NEW ore-buying station-sampling plant installations will be opened by the Atomic Energy Commission this summer; at Green River, Utah and Globe Ariz. Both will be operated by the American Smelting and Refining Co.



DESPITE THE INCREASE IN THE PRICE OF ZINC, it does not appear to be out of line with other commodities and competitive materials, observes Charles R. Ince, vice president and sales manager, St. Joseph Lead Co. Even with the 1954 rise of 1.5c per lb, zinc is only 87% of the Commodity Price Index, with lead at 86% and copper and aluminum at 127% and 131% respectively. The price of metal was certainly not a factor in the lower consumption of zinc during 1954. Decline was due to the drop in general industrial activity and, in particular, steel operations, but varied to a considerable degree among the zinc-consuming industries. (The above is reprinted from Mr. Ince's review of zinc in the February 1955 issue of E&MJ.—Ed.)

which also operates ore-buying stations for AEC at Monticello, White Canyon, Moab and Marysvale, Utah, and at Edgemont, S.D.

AS&R-managed sampler and crusher at Riverton, Wyo. was opened March 1, with five truckloads of uranium ore. Sheldon Wimpfen, manager of the Grand Junction AEC office, telegraphed townspeople that a mill will be built in the area to serve the Gas Hills district as soon as sufficient ore reserves were delineated.

Community Consultants Urge Townsite Analysis

PROBLEM OF IMPROVED LIVING CONDITIONS in the remote areas where mining takes place is discussed by Nathaniel S. Keith and Carl Feiss, Washington, D. C., community planning consultants, in a recent pamphlet.

Noting that discoveries of important raw materials take place in undeveloped areas, the consultants recommend analysis of future construction and development with an eye to producing greater efficiency of employees and minimized staff turnover.

Also included among recommended considerations are: commutation distance, public utility sites, school and recreational installations, parks, churches and commercial facilities, plans for future expansion.

Iron Ore Shipping Begins With Capacity Sailing

THE 59-SHIP FLEET OF Pittsburgh Steamship division, U.S. Steel Corp., was scheduled to sail for Lake Superior April 4. Donald C. Potts, president of the division, said the entire fleet will go into operation this year, noting that there is "every indication" that the 1955 season will exceed '54.

Annual meeting of the division was held in Cleveland March 22 and 23, with traditional annual dinner of captains and chiefs on the latter date.

Hoover's Home Restored

HERBERT HOOVER'S boyhood home in Newberg, Ore. has been purchased and is being restored by the Herbert Hoover Foundation, a group of former fellow townsmen and friends. Purpose of the Foundation is to restore the house and furnishings to original condition, including photographs, portraits and documents.

After the death of his parents in his early youth, Hoover lived with his uncle, Dr. H. J. Minthorn, in Newberg, and attended the Friends Academy. He remained in the town until going to Stanford.

Dr. Burt Brown Baker, vice president of the University of Oregon, is receiving donations for the Herbert Hoover Foundation at 3438 S.W. Brentwood Drive, Portland, Ore.

Atomic Energy Commission calls its new pilot mill in the compound of the Grand Junction operations center a "king-sized test tube." Ore from new discoveries over the Colorado Plateau is brought here to determine what process and which mill can best refine that particular type. The new pilot plant employs both alkaline and acid leaching. A small plant in use earlier could test only acid leaching processes. National Lead Company is operating the twin mills under contract with the AEC. R. F. Hollis is manager.

Inspiration Copper Co. Studies New Leases

Richard S. Newlin, president of Inspiration Consolidated Copper Co., informed shareholders that the company has an 18-month option to acquire the properties of the Christmas Copper Corp., located 45 miles south of Inspiration, in Arizona. Newlin said an option has also been taken on claims owned by the New Year Mining Co., west of the Christmas property.

"It is too early to predict what our future plans for this property may be," the company president said in the annual report to stockholders, "or to foresee with any accuracy what full development and equipment may cost." He added that the directors "feel the company should be prepared to spend possibly $7- or $8-million for this purpose."

Inspiration reported earnings for 1954 as the best since 1918. An important factor in maintaining good income level was said to be the expiration of excess profits taxes. The company plans to treat additional tonnages of Inspiration's copper-bearing ore of a lower grade than now being processed.

Mining Calendar

Colorado School of Mines Engineers' Day, April 15-16, Golden, Colo.

Canadian Institute of Mining and Metallurgy, annual meeting, April 19-21, Royal York Hotel, Toronto, Ontario.

American Zinc Institute, 37th annual meeting, April 28-29, Drake Hotel, Chicago, Ill.

Uranium Ore Producers' Association, May 6-8, Grand Junction, Colo.

New Mexico Geological Society, 9th annual meeting, May 13-15, at Gallup, N. M. Field trip through Gallup-Grants uranium district.

Four Corners Geological Society, field conference, June 15-17, Paradox Salt Basin.

UNITED STATES RUBBER COMPANY
COMPLETES IMPORTANT
4-YEAR TRUCK TIRE PROJECT. *Results...*

Much Less Downtime... Greatly Increased Mileage...

"Downtime practically eliminated"
says P. Carreale, Carreale Construction, Hazleton, Pa.

"There's no tougher test for tires than anthracite coal stripping. A tire failure here can knock out a truck for a full 7-hour shift—*for a $400 loss.* With their terrific carcass strength, U. S. Royal Con-Trak-Tors have *practically eliminated* our downtime."

"A 32% increase in mileage"
says Ben Gerttula, A. A. Kerry Logging, Taft, Ore.

"Our trucks haul timber out of the forest, over steep mountain roads to the mill. We tried 8 different makes of tires on the job. Now we use U. S. Royal Fleetmasters, because they average a *32% increase in mileage* and 2 more recaps!"

From leading truckers of every type and size, all across the land, comes *evidence* of the outstanding performance of the new U. S. Royal Truck Tires—the result of a determined 4-year project recently completed by U. S. Royal engineers.

The three results of this project most frequently mentioned by truckers are: 1) *much less tire downtime;* 2) *greatly increased tire mileage;* 3) *far lower cost per tire mile.*

Exclusive U. S. Royal processes account, in the main, for these important results. Patented INFRA-RED ray treatment prevents groove-

U.S.

"Tire costs below a mill-per-mile"

says Guy Cooper, Cooper-Jarrett, Motor Freight, Chicago

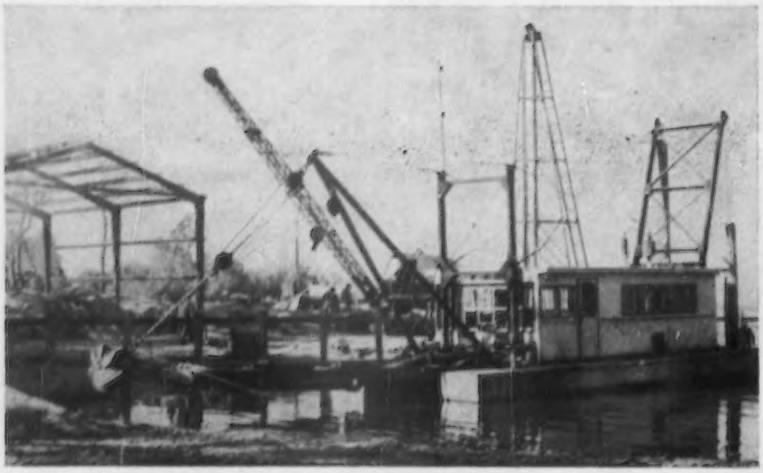
"In a multi-million mile operation like ours, a fraction of a mill-per-mile means real savings. Our most recent records show that U. S. Royal Fleetways have enabled us to keep our tire costs below a mill-per-mile..."

Far Lower Cost Per Mile!

cracking. Special ROYAL CORD processing pre-stretches the Nylon or Rayon, reducing "tire growth" while maintaining the cord's natural shock absorbing strength. Exclusive PYRAVIN bonding solution surrounds each individual cord—fortifies it against heat and friction.

Today—no matter what your trucking job—there is a U. S. Royal Truck Tire capable of doing it better and at lower cost. And wherever you go, there is a U. S. Royal Dealer to give you expert tire service. Ask him to show you *why* truckers report they're *well ahead* with U. S. Royal!

ROYAL TRUCK TIRES



Suction dredge at Cove Point, Md., property of Tiorco takes black minerals from shallow waters. Beach, inland areas and bay bottoms all have shown deposition.

Probing Maryland's Beaches For Rich Titanium Sands

TITANIUM ORES CORP., Cove Point, Md., is moving toward production of 120,000 lb of titanium ores per day from beach sands and the bottom of Chesapeake Bay near its crescent-shaped property 65 miles south of Annapolis.

Charles E. Jefferson, Silver Spring civil engineer and president and director of Tiorco, discovered the deposits in 1951. Jefferson first became interested in the heavy black mineral sands when he discovered a deposit in 1938 during a Florida drilling operation.

Jefferson conducted tests to determine nature and extent of the deposit, both inshore and under the shallow waters of the bay, the latter with the permission of the Department of the Army. Five-foot test holes inland and on the beach were made, as well as those in the shallow water, and all showings indicated mineral concentrates with blacker samples at depth. Open pit holes to 17 ft confirmed the existence of titanium mineral concentrates, with some samples running 5 lb of heavy minerals to 100 lb sand.

During the early exploration, 800 lb taken from more than 60 test holes were tested in a Cannon separator. When dry, they were run through electrostatic and electromagnetic separators of the Carpco Engineering Co. with the following product analysis:

Ilmenite	65.5%
Rutile	3.1%
Zircon	16.2%
Waste	15.2%

Jefferson believes that action of winds and tide, swirling against the 1¼-mile crescent owned by Tiorco, deposited the minerals, which he believes originate from eroding cliffs on the west shore of the bay. Basing his estimate on the centuries involved, Jefferson hopes to find deposits inland for ½ mile, the western boundary of the Tiorco property.

Discoverer Jefferson and vice president Rogers examine upper structure of giant Cannon separator.

Ore-bearing sand, just as it is found on the beach and dredged from the bay bottom, will be sifted through a triple-deck vibrating screen and then run through the Cannon separator—believed the largest yet constructed—which is capable of handling five tons wet concentrate per hour.

Bonus on the $300,000 operation will be calcium carbonate from seashells, which Tiorco hopes to convert to agricultural lime and poultry feed.

Following Cannon treatment, the minerals will be passed over Carpco separators to obtain ilmenite, rutile and zircon. Shipping from Cove Point will be via Chesapeake Bay.

Officers of the corporation include: Jefferson; John B. Rogers, vice president and director, who is owner of Tidewater Pier and Dredging Co. fabricators of some of the heavy equipment at Cove Point; Eller Lutes, secretary-treasurer and director, and director of production for Arcrods Corp., large consumer of ilmenite, rutile and zircon; John M. Hardy Jr., assistant treasurer; and Harry Cannon, consulting geologist, inventor of the Cannon separator and participant in the exploration at Du Pont's Trail Ridge operation near Starke, Fla.

IN THE U.S.

ALASKA

Kodiak Exploration Co., Inc., has staked 17 claims on a scheelite showing on Kodiak Island.

Gilmer Lode Mining Co. of Fairbanks is reopening the old Danzenger lead-silver prospect in the Bonnifield District. Last fall they took in a bulldozer, compressor, and other equipment from Ferry, on the Alaska Railroad, and built a landing strip near the property. They are now reported to be opening the old workings.

ARIZONA

Upetco and Silver Reef Uranium companies are developing 80 claims in House Rock Valley near Marble Canyon, north of the Upper Grand Canyon in northern Arizona.

The claims were purchased by Upetco and Silver Reef in a 50-50 deal. Jesse Abernath, Upetco field superintendent, is directing the development and mining program. Ore will be shipped to the Marysvale, Utah, buying station.

A.M. Buranek, Upetco geologist, said ore zones are exposed up to 60 ft in length with a minimum thickness of 6 ft. Initial shipments made by locators assayed up to 50% uranium oxide.

Standard Ore and Alloys Corp. has negotiated a contract with Uranium Corporation of America covering developments on a low-grade A-ore deposit near Cutter (Globe).

John White, former president of Climax Uranium Corp., and now head of western offices for Standard Ore at Salt Lake City, handled the details for his firm.

Announcement by K. Ralph Bowman, Uranium Corporation of America, stated that Standard Ore also had signed agreement to build a mill in area, contingent upon development of ore reserves.

The state is contemplating some means of controlling the uranium boom—and its resulting property damage. In some sections "gopher" action of prospectors has brought a storm of protests. Some property owners have reported the ground is "being cut right out from under them."

Roger Ernst, state land commission, in discussing the problem with representatives of groups concerned with the sub-

GENERAL REFRACTORIES

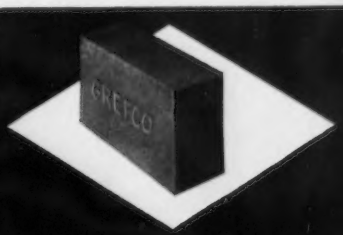
FILET MIGNON—a la BRICK Sizzling, savory, juicy—dripping with butter—dashed with Worcestershire—and all of it brought to your table because of brick—refractory brick.

Refractories that contain the flames of industry. That produce the steel for your stove, your cabinets, your cooking utensils . . . provide the heat for the oven, the cold for the refrigerator . . . make rails, cars and engines which bring your steak to town; the wheels, body and motor of the truck which delivered it to the butcher. The platter on which it is served. The knife to cut it. The fork to eat it. The lights for the table. All—born of refractories.

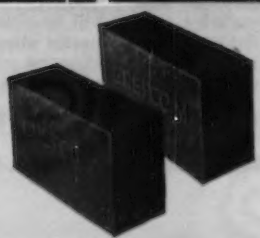
Practically everything made or moved requires refractories. Refractories of almost infinite variety, prescribed and tailored for each special task.

Developing them, producing them, applying research to their improvement, drawing on resources all over the world, is the complete refractories service that we provide to industry, everywhere.

GENERAL REFRACTORIES COMPANY
PHILADELPHIA 2



A COMPLETE REFRACTORY SERVICE

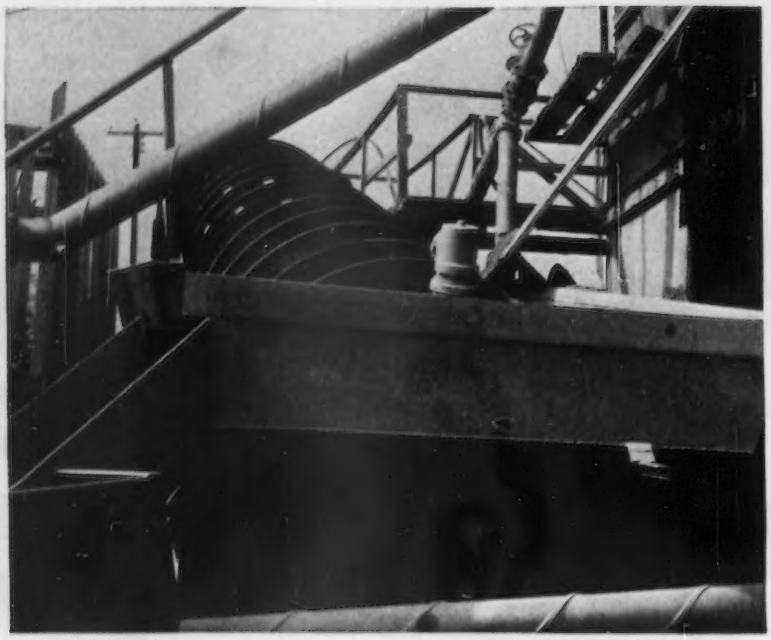


GREFCO K—A superior burned magnesite brick, particularly recommended for its high resistance to strongly basic oxides.
GREFCO M—A chrome magnesite brick which gives a unique combination of good resistance to basic slags, load, abrasion, and thermal shock.

RITEX—Unburned basic brick—in magnesite, magnesite-chrome, and chrome-magnesite. More resistant to spalling. Lower porosity, lower thermal conductivity—high hot strength.

KING SIZE PERFORMANCE

with NAYLOR *Lightweight Pipe*



It's no trick to get king-size performance from air and water lines in mining service when you use Naylor large diameter lightweight pipe.

Naylor is the one lightweight pipe built to handle jobs normally requiring heavier wall pipe. That's because of Naylor's exclusive lockseamed, spiralwelded structure which creates a pipe that is recognized for its greater strength and safety.

Its light weight makes Naylor pipe easier to handle and install, particularly with the one-piece Naylor Wedge-Lock Coupling to speed connections. Pipe sizes range from 4 to 30 inches in diameter.

For the complete story on this distinctive combination, write for Bulletins No. 507 and No. 513.

NAYLOR PIPE

Naylor Pipe Company • 1243 East 92nd Street, Chicago 19, Illinois

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Arizona *(Continued)*

surface and surface use of Arizona's public domain, reports:

"We already are losing grasslands and even farming lands at the rate of hundreds of acres a day as the result of the activities of thousands of weekend and vacation prospectors who are digging away all over the state.

LeRoy de Montiel, Nogales, has sold half interests in his Tyndall Mining District uranium claim to Lewis H. Larson, Salt Lake City, for $125,000. The property is in Southern Arizona.

Department of Interior has ordered restored to public domain 123,540 acres of Arizona land originally withdrawn, but no longer needed, for reclamation purposes along the Colorado River. Veterans have a 91-day preference, dated from Feb. 23, for filing occupancy applications.

The mining industry in Arizona paid 22.12% of the total state property income and production taxes over a 6-year period from 1949 to 1954, the Department of Mineral Resources reports. During that time mines produced $1,317,559,000 worth of metals, or 19.09% of the total state income of $6.9-billion.

Rare Metal Co. of America has taken over all capital stock of Arrowhead Uranium Co. and property near Cameron where it is surveying ore reserves prior to constructing a mill. Arrowhead is a Colorado-based corporation headed by John R. Munro of Grand Junction. Rare Metal is owned by El Paso Natural Gas Co., Western Natural Gas Co., and their employees.

CALIFORNIA

Kaiser Aluminum & Chemical Corporation has purchased 353 acres of dolomite property adjoining its chemicals division plant site at Natividad.

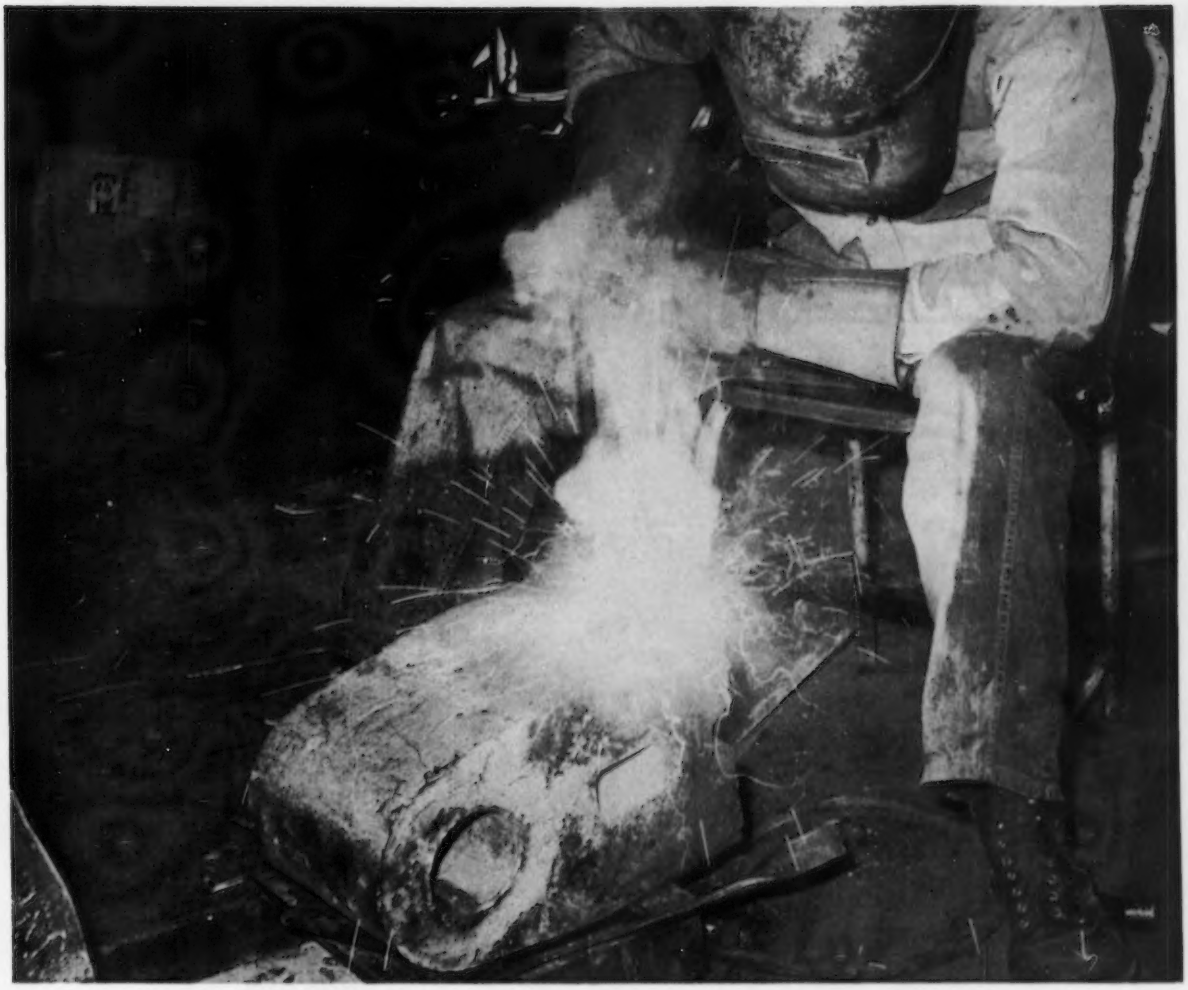
Purchase extends corporation property holdings in Monterey and San Benito Counties to approximately 750 acres including both operational areas and dolomite reserves.

Dolomite is quarried and processed at the Natividad plant. While some is used for roofing rock and agricultural limes, calcined dolomite is shipped to the corporation's seawater plant at Moss Landing, 15 mi away, for processing into magnesia.

Glidden Co. is spending $30,000 a month on exploration at its Bully Hill mine near Redding. A new orebody has been discovered on the zinc property, and vice president John P. Ruth said company officials are optimistic as a result of the findings.

Crews work seven days a week, mining ore for stockpiling. After a concentration plant is installed a system will have to be devised for moving ore from the plant to the nearest railroad. In charge of the Bully Hill operation is Edward L. Ralston.

Interest is growing in El Dorado County



KING SIZE SWING HAMMERS
Last 10 Times As Long With Stoody Hard-Facing

A large bauxite mill in the South crushes limestone used as a flux in the reduction of the ore. The hammer mill used here has 15 hammers to the set, each hammer weighing 300 pounds. Rotating at 750 RPM, the hammers are subjected naturally to extremely severe abrasion and impact—edges and corners are soon rounded off, resulting in greatly reduced efficiency and lowered production of properly sized aggregate. Ordinary manganese hammers operated for only one week; *as hard-faced, they now last 10 weeks!* Spare sets are available at all times for installation in the mill while the worn parts are being rebuilt.

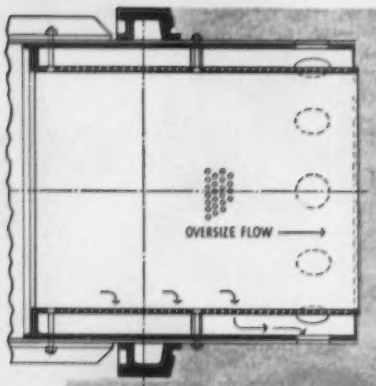
Standard procedure now consists of bringing wearing areas back to size with Stoody Nickel Manganese, topped off with a final pass of Stoody 21. As a rule only about 12 to 15 pounds of manganese are required for rebuilding and two pounds of Stoody 21 completes the hard-facing.

Detailed information on maintenance of all types of crushing equipment is contained in the Stoody Guidebook, a copy of which you can obtain from your Stoody dealer (see the yellow pages of your telephone book) or you may write directly to Stoody Company. This famous manual is available without charge, of course.

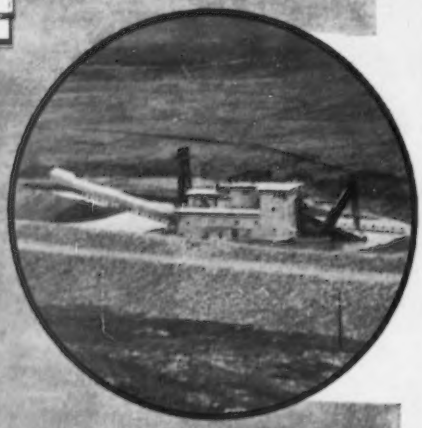
The hammer in the foreground shows the metal loss in operation: leading edges have been completely worn away.

A hammer rebuilt and hard-faced, ready to be returned to the mill. Hammers can be reclaimed many times and service life prolonged indefinitely.

STOODY COMPANY
11940 East Slauson Avenue
Whittier, California



First Olson trommel was installed in YUBA 8 cubic foot dredge (below) at Platinum, Alaska. This trommel (left) mounts in screen in area normally blanked out and increases capacity as much as 25% without lengthening screen.



GOODNEWS BAY REPORTS

4½ YEARS USE AND 5,000,000 YARDS HANDLED BY YUBA-BUILT OLSON TROMMEL WITHOUT DOWNTIME

L. F. Barber, chief mining engineer, Goodnews Bay Mining Co., writes:

"The Olson section installed in the 7½ foot Trommel Screen, Yuba Dredge No. 129, has now been in operation in excess of four and one-half years...almost five million cubic yards of material have passed through the screen.

"The Olson section was designed to provide additional screening area over the screen section normally blanked out by the lower tread ring and end plates. The effective screening area now extends nearly the full length of the screen, allowing additional flexibility in the routing of screened material over jigs and sluices in the recovery system. The ¾" Yuba Abrasion Resisting Steel internal perforated plates of the Olson section wear in excess of two mining seasons. Plates are changed during Spring repair every other year to preclude lost time during the mining season.

"Regardless of material—whether sticky clay, muck, overburden, fine sand or gravel—the Olson section has not plugged up nor caused any lost time since its installation in 1950."

FOR OLD OR NEW REVOLVING SCREENS

Olson patented trommels, made from ARS plate with holes taper drilled to size and spacings you need, can be field mounted in your present screen or built into new screens at the YUBA plant. In either case you increase screening capacity and effectiveness without lengthening screen. Send screen details, general arrangement, hole size and spacing for estimates. No obligation.

YUBA DREDGES — PROVED DEPENDABILITY ROUND THE WORLD

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88

California *(Continued)*

as a potential uranium producer. Between October and January, 65 claims were filed, most of them in the Lake Valley region at Lake Tahoe or the Carson Spur area near the Amador County line.

Exploration program for metallic and nonmetallic minerals has been organized by Southern Pacific Co. to cover 5-million acres of company land and reserved mineral rights in California, Nevada and Utah.

D. J. Russell, president of the railroad, said the land department of his office had been expanded and that survey would take about eight years.

COLORADO

An orebody in the Uravan area that may prove to be Colorado's biggest discovery yet is being developed by the Barton Uranium Co., with five drifts being operated in addition to drilling.

David M. and Stanley W. Barton of Sikeston, Mo., officers in the family-owned corporation, said $1,500,000 worth of ore has been blocked out on two of the company's 38 claims. Geologists believe the total holdings may be worth $50-million. Stanley Barton said. Company has spent nearly $500,000 so far in acquiring claims and in exploration and development work.

The claims, known as the Pay Day group, are on Martin Mesa, 12 mi west of Uravan on the west bank of the Dolores river. Drilling has disclosed ore ranging from 4 to 18 ft thick with assays running from .38 to .53% uranium oxide, and development ore has returned $22.50 a ton for vanadium in addition to uranium values.

William Doertenbach of Pueblo, Colo., is mining superintendent and Fred Hohne, Minerals Exploration Research Corp., is geologist for the Bartons. All Barton stock is owned in the family.

Annual meeting and exposition of the Uranium Ore Producers Assn. will be held in Grand Junction May 6-8, with Norman Ebbley as convention chairman.

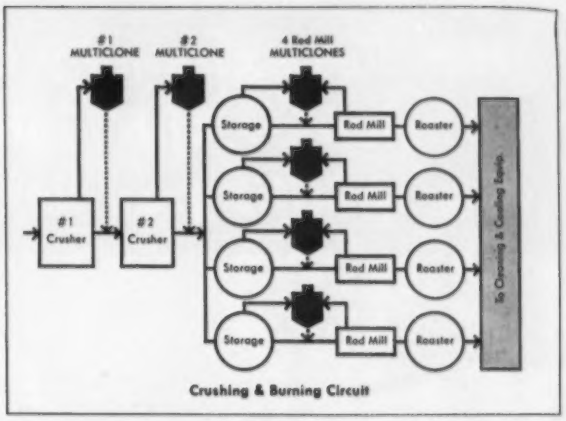
On the convention committee are Tom Skidmore, president of UOPA; A. C. Rinderle, C. G. Ortmayer, John Schumaker, Jack O. Jones, W. T. Hutt and L. A. (Kim) Theobold.

American Mineral Development Corp. plans to build a thorium refining plant at Canon City, "in the immediate future," E. W. Ohlson Jr., partner in the firm, has announced. The corporation holds mineral leases on 1,320 acres in the Oak Creek district about 17 mi south of Canon City, in the same general vicinity where Climax Molybdenum Co. holds extensive leases.

Purchase of eight new claims in the Cochetopa area of Sagauche County for $50,000, plus 15% royalty, was announced by the Thornburg Mining Co.

The claims, known as the Elisha group, are northwest of the Los Ochos claims now being developed by the Thornburgs.

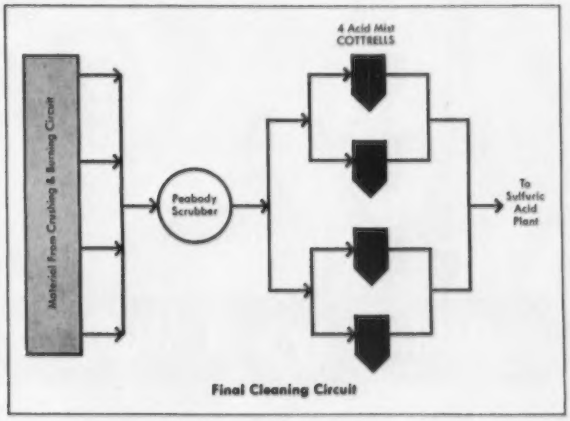
6 MULTICLONE DUST COLLECTORS



Crushing & Burning Circuit

and 4 Western Precipitation COTTRELLS *serve Anaconda at Yerington!*

These Cottrells are the newest Western Precipitation acid mist design



Final Cleaning Circuit

Anaconda selected six Western Precipitation MULTICLONES and four Western Precipitation COTTRELL Electrical Precipitators to handle key recovery operations at its new $30,000,000 Yerington installation.

THE 6 MULTICLONES are installed in the sulfur crushing plant where sulfur ore is crushed and ground for use in the Roaster operations. Since this crushing and grinding develops a considerable dust problem, the primary crusher (a jaw type), the secondary crusher (a cone type), and each of the 4 rod mills has an individual 9VG Multiclone Mechanical Collector installed for recovering suspensions from the exhaust gases.

So efficient are these Multiclones that the exhaust gases are practically free of all visually discernible dust!

Inasmuch as each crusher and mill has its own Multiclone unit, maximum flexibility in plant operation is achieved—with greatly simplified duct and dampering requirements. Savings in plant maintenance are also obtained by having the Multiclones ahead of the fans so that abrasive dusts are removed and only the clean gas reaches the fan equipment.

THE 4 COTTRELLS are installed in the acid plant process to electrically precipitate the acid and water mist from the SO_2 gas generated in the Fluosolid Roasters. From the Cottrells the gas passes directly into the contact acid plant where it is converted into sulfuric acid.

The four Cottrells have 100 pipes each, and are designed for a capacity of 33,900 cfm at 110°F. with a negative pressure of 30″ w.g. and a recovery efficiency of 99.0%!

These Cottrells are the first acid mist precipitators to incorporate a new advancement developed by Western Precipitation engineers... top support of the high voltage electrode system coupled with wind-swept insulator compartments. This new design eliminates difficulties associated with conventional oil-sealed insulator compartments and is a major advancement in this type of Cottrell design.

The Weed-Heights installation is one more example of the flexibility and adaptability of Western Precipitation recovery equipment to varying operating requirements. Remember — Western Precipitation designs, engineers and installs BOTH *electrical* (Cottrell) and *mechanical* (Multiclone) recovery systems — therefore can give an unbiased recommendation on the type best suited to your particular requirements. A wire, letter or phone call to our nearest office places this unmatched "know-how" at your service!

Send for helpful literature!

WESTERN Precipitation CORPORATION

DESIGNERS AND MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1012 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
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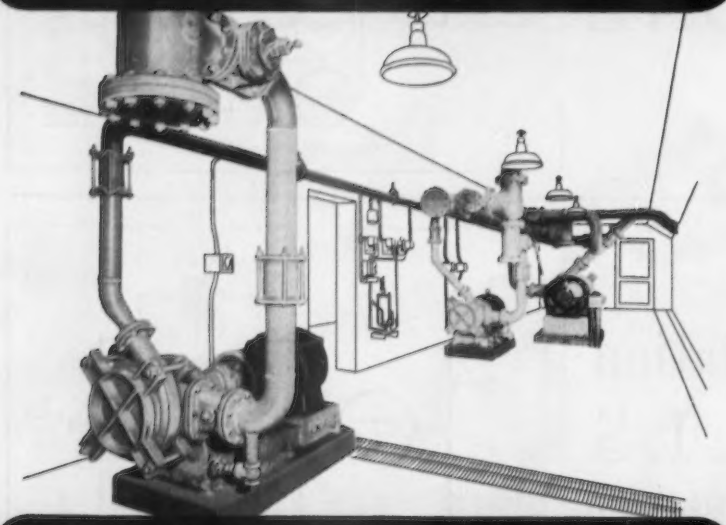
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

® "Multiclone"

Handles extremely thick slurries with high specific gravities



MORRIS Type R SLURRY PUMP

Heavy viscous slurries with solids ratios as high as 70% by volume are not unusual loads for a Morris Type R Slurry Pump.

A case in point is this Morris installation at the Missouri Portland Cement Co., St. Louis, Mo. The two Morris 3R Pumps in the foreground each handle 200 GPM of a cement slurry at 64% solids with 1.66 specific gravity. Speed is 1180 RPM. The 6R Pump in the background handles 600 GPM of the same slurry at 880 RPM.

Long operating life...
little or no maintenance

Massive running parts of the Type R compensate for the increased load imposed by high specific gravities. Hydraulic passages are deliberately designed for high concentrations of solids—the result of careful study of wear patterns shown by pumps in the field handling all kinds of abrasive materials. Elimination of areas of throttling and turbulence assures uniform wear of all parts.

There are no internal studs or bolts—no troublesome internal joints and fits. The suction disc liner is merely *clamped* into position between disc and shell. The absence of high stress on the shell permits wide variations in its composition—including materials of high abrasive resistance—to resist wear and extend the operating life of the pump.

Let our engineers consult with you on your slurry pump problems. They'll give you the benefit of 88 years of pump-building experience. Or, write for Bulletin 181.

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MORRIS *Centrifugal Pumps*

Colorado *(Continued)*

Garth and Vance Thornburg also announced they have spent $100,000 in development work at their Blue Rock mine in the Rincon mountains of Arizona, east of Tucson, and already have more than 500 tons of ore stockpiled on the property. Minerals Engineering Co. of Grand Junction is drilling the 31 Thornburg claims, and Garth Thornburg said commercial ore has been encountered on all claims, with an indicated 25,000-ton body on one claim alone. Values are expected to average .25%.

Geologic map showing uranium, vanadium and copper deposits of the Colorado Plateau now is available for purchase from the U. S. Geological Survey, which prepared it for the Atomic Energy Commission. No. MF-16 of the USGS mineral investigation field studies series, it is available at the Geological Survey Map Distribution Section, Washington 25.

The map includes a short text describing the history of production, general geology, and major uranium, vanadium and copper formations and ore deposits.

Drilling companies operating on the Colorado Plateau have organized as the Uranium Drillers Assn. of America, with headquarters at Grand Junction.

Temporary officers are Richard Travis of the Dawn Drilling and Mining Co., president, and Jack Rigg of Minerals Engineering Co., vice president. Purpose of the association is to set drilling standards for the uranium industry, study mutual problems and act as a clearing house for unclassified information on uranium operations.

Travis said about 20 drilling companies now are operating on the Plateau.

Three uranium mining firms in Montrose and San Miguel Counties received Government aid totaling $78,961 during the last quarter of 1954 under contracts with the DMEA.

Included in the aid program were: United States Uranium Co. of Montrose, $23,762; Ray Ryan of Montrose, $50,204; Aztec Mining Co. of San Miguel County, $4,955. In another contract Harold and Thomas Williams of Boulder County received $10,050 for a tungsten exploration project.

Farmington Funding Corp. of Colorado Springs announced it planned to start development work soon on the Ralston Creek uranium mine near Golden.

The corporation purchased the property from Fred Swartzwalder, Golden high school janitor and amateur prospector, who made the reportedly rich discovery. AEC spokesmen described the strike as "one of the most significant" on the Front Range.

After spending six months examining coal deposits in the Craig area, Utah Construction Co. reportedly is prospecting for uranium in Big Gulch.

Silver receipts at the Denver mint in January were up steeply from January 1954 intake, but gold receipts declined

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drill a portion of the estimated four million feet of uranium exploration in 1955?

The Atomic Energy Commission's program of undertaking a large portion of exploration core drilling in the past has borne fruit. Exploration activity by private companies had increased to a point in 1954 where over three million feet were drilled and estimates for 1955 are placed at over four million feet of exploratory drilling. But, with this increased activity operators are demanding improved techniques and equipment, faster drilling, lower costs, deeper holes and larger cores with higher percentage of recovery.

Because of the variety of rigs now in use for uranium exploration, Christensen Diamond Products Company has prepared a brochure on recommended associated equipment, to be used in conjunction with these various type drills. This brochure is offered free upon request and lists such items as recommended pump, recommended core barrel, drill rod, OD tool joints, etc.

A well planned exploratory drilling program means greater profits for you so why not avail yourself of Christensen Diamond Products Company's vast experience to help you select the right bit and core barrel combination for your uranium drilling?

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Colorado *(Continued)*

sharply. Mint officials were unable to explain the drop in movement of gold. Gold receipts for the month were down to 58,695 oz valued at $2,054,352 from 84,912 oz worth $2,971,941. Receipts of silver were up to 585,159 oz worth $529,371 from 309,966 oz valued at $280,427 a year previous.

Rumors that the Government is proposing to stockpile 20 million pounds of thorium are in error. Jesse Johnson of Grand Junction, director of the division of raw materials of AEC, says it has been accumulating a limited stockpile of thorium salts for research purposes. The salts have been purchased as a by-product of commercial plants treating monazite sands, he said.

"At the present time," he said, "there is no price schedule. The Commission would be interested in learning of domestic thorium reserves and would consider proposals to purchase a limited quantity of thorium salts."

Marlong Thompson and Edward Swindt reportedly discovered a rich body of pitchblende on Collier Mountain near Montezuma, the extent of which is unknown. Property has been visited by a group of geologists who believe that the mine might be a substantial source of high-grade uranium.

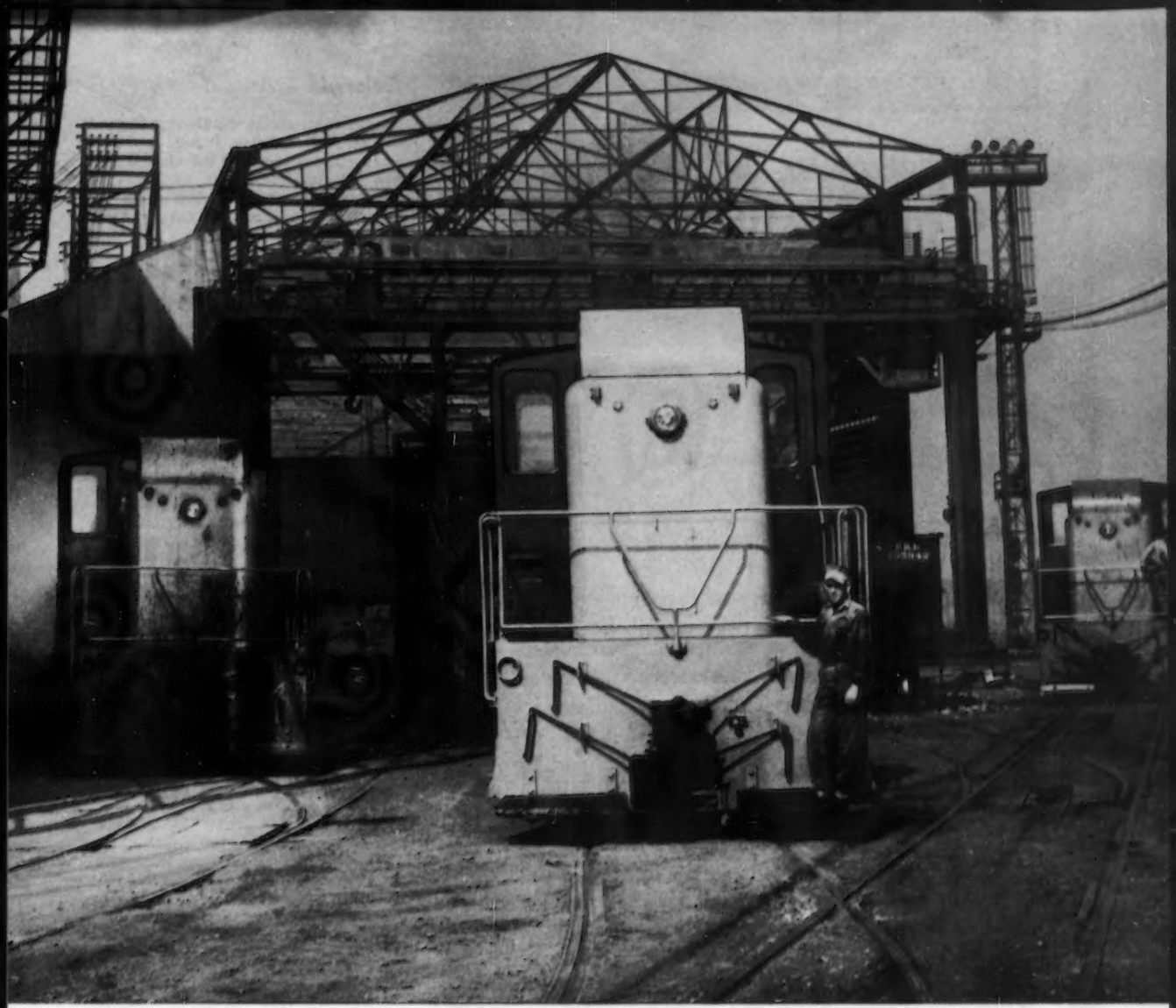
Company also has acquired the Chataqua mine and mill, the Pay Master mine and all of the equipment. The company will be under the direction of Tom E. Martin and Patrick J. Vinson, both of Montezuma. They are embarking on a program of developing their present holdings and prospecting for new ores for new discoveries in this district.

In Montezuma county, the first uranium production has been announced by H. N. Chowing of Cortez by Le-Rue Mining Co. Shipment was made to the Kerr-McGee mill in Shiprock, N. M. Chowing is also manager of Buckeye Mining Co. Both companies own four claims each in the extreme northwestern section of Montezuma county.

Thousands of uranium claims have been staked in the county, principally in the west end and in the La Plata mountain areas. Ute Mountain Indians have issued a prospecting permit to R. N. Usher of Cortez, and some development on the Ute reservation might well be seen in 1955 according to reports.

Ore samples running as high as 16 oz to the ton have been found on the fifth level of the Dante mine at Cripple Creek by Al Goodwin, who is leasing on this Gold Sovereign operation. Ore was discovered by Goodwin while he was drifting to the Dante to take out the old shaft pillars. The ore occurs in three streaks across the face of the drift and shows high content of sylvanite and free gold.

AEC will explore for uranium ore in coal-rich Moffat county. Bids for drilling and exploration contract in the western slope county were invited by Charles C. Towle, chief of the exploration division of the AEC raw material branch, which



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Colorado *(Continued)*

has headquarters at the Denver Federal Center. Prospecting activity is under way in the county and the Government will let the contract in an effort to obtain additional information about the area's geology. Contract calls for 5,000 ft of drilling.

IDAHO

Highland-Surprise Consolidated Mining Co. has sold to New Silver Bell Mining Co. of Almira, Wash., a half-interest in its 29-claim uranium prospect in the Henry Mts. area of Garfield County, Utah. Terms of the purchase agreement provide that the new partner pay to Highland-Surprise a $2,500 cash down payment and also finance the first $5,000 of diamond drilling and exploration. Subsequent exploration costs will be borne equally by both firms. Plans are to start the core-testing program as soon as weather conditions permit.

Highland-Surprise is also making preparations to start work this spring on its recently-acquired Deer Trail and F.D.R. properties in Custer County, Idaho, near Stanley. Application has been filed with the DMEA at Spokane for 50% Federal assistance on a $139,552 lead-zinc exploration project involving diamond drilling drifting and crosscutting on the two groups.

Sunshine Consolidated Inc. had about the best year in its history in 1954, with production up over 50% from 1953 and the grade of ore somewhat better, according to Norman Smith, directing engineer. Quarterly output improved steadily throughout 1954 and silver values in the ore averaged more than 45 oz per ton as compared with about 41.5 oz in 1953.

There was also a substantial amount of development work completed last year, but still only a relatively small portion of the Big Sun Con property on the west flank of Big Creek in the Coeur d'Alene District has been explored to date. The property is being operated and developed by Sunshine Mining Co. from the lower levels of its Jewell shaft under a profit-sharing agreement.

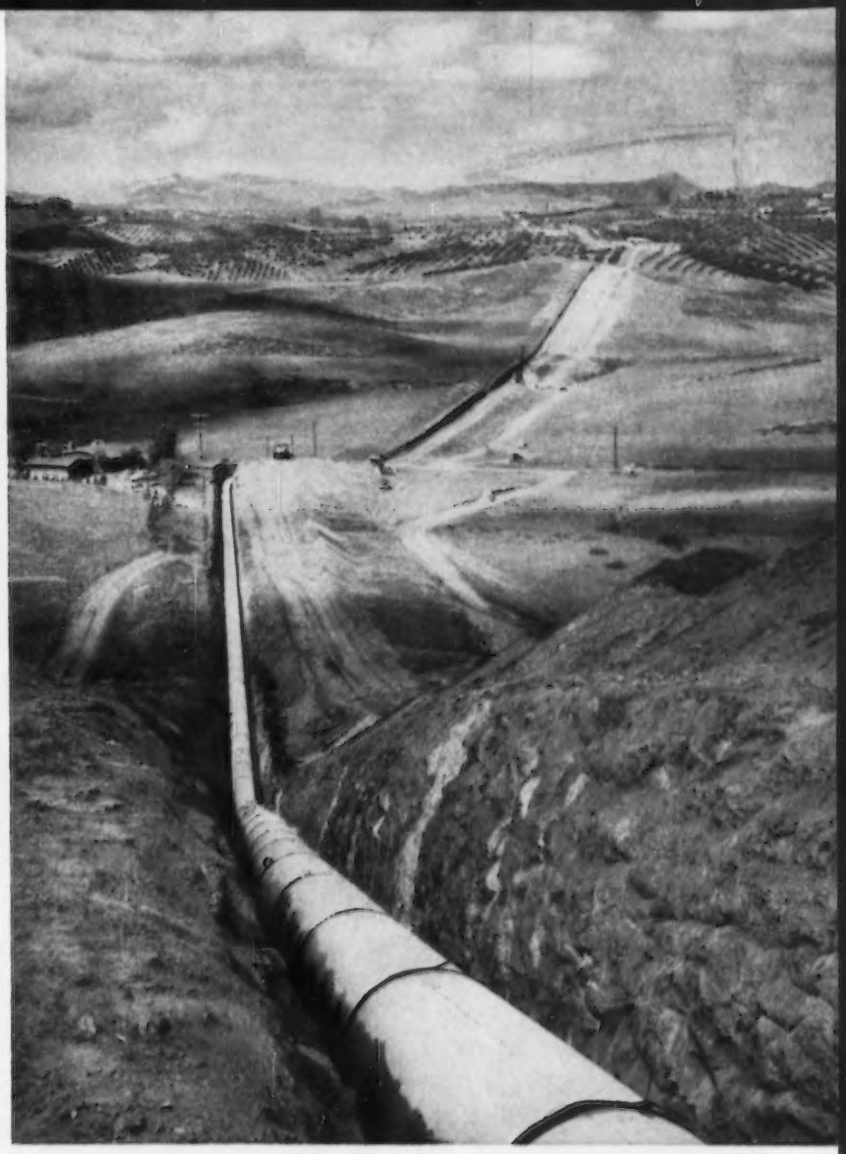
Stockholders of Nevada-Stewart Mining Co. have approved and ratified an operating agreement with Sidney Mining Co. which provides for deep-level exploration and development of Nevada-Stewart property from the bottom of the Sidney main shaft, now being deepened from the 1700 to the 2300 level under a contract with DMEA.

Under terms of the agreement Sidney will finance the exploration and development program in adjoining Nevada-Stewart ground and will receive 90% of any profits until its costs have been reimbursed. Subsequent profits will go 65% to Sidney and 35% to Nevada-Stewart.

Idaho Mining Co. informed stockholders in February that unless additional financial support is forthcoming it may be necessary for the firm to abandon within

ACROSS HILLS AND VALLEYS

Explosives Research Pays Off



Blasting trenches in hard granite formations to install a pipeline in Southern California called for engineering skill, operating know-how, and a knowledge of explosives.

Over hills and valleys and across rivers and gorges, pipelines provide safe, sure, economical means of transportation for petroleum, natural gas, water, and other mineral resources. When rock is encountered, blasting crews with specialized explosives take over. Here is where explosives research pays off.

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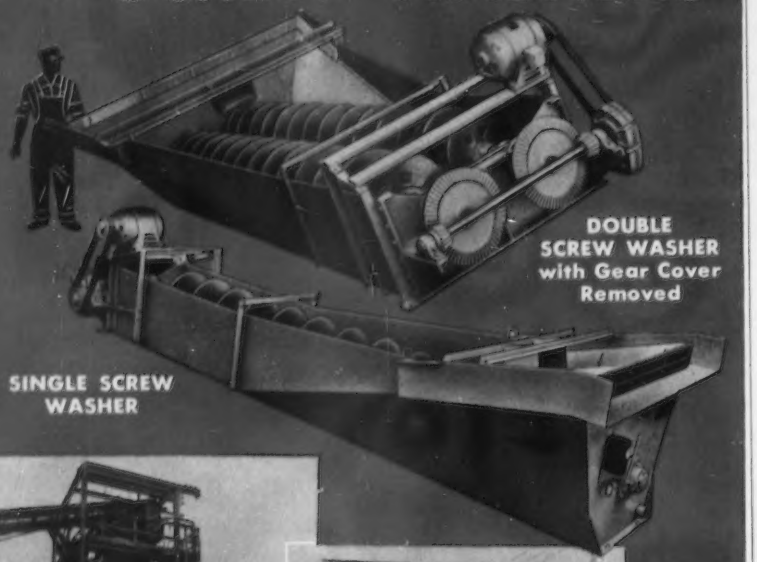
SCREW WASHERS



McLanahan Screw Washers provide the ultimate in equipment for efficient, low cost dewatering, classifying and removal of foreign material and water from fine or coarse materials.

These washers contain many outstanding features, including: grease lubricated anti-friction bearings throughout, easily removed without disassembly—extra large settling area—enclosed reduction drive—flights are cast chilled alloy iron for extreme hardness and resistance to wear.

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255 Wall Street, Hollidaysburg, Pennsylvania

Idaho *(Continued)*

a few rounds of its objectives the exploration project it has been carrying on with DMEA assistance at its 24-claim property on Moon Creek northeast of Kellogg.

If sufficient funds can be raised to liquidate current indebtedness, Pioneer Corp. of Kellogg will undertake to lease and operate the property and help finance completion of the project and construction of a flotation plant on the property, if warranted, stockholders were advised.

Extensive plant improvements have enabled Sullivan Mining Co. to maintain production at about 20,000 tons of ore per month at its Star Mine at Burke, the state's leading zinc producer, with fewer men and a shorter work-week. The improvement program included driving an 8500-ft surface adit tunnel to eliminate handling of ore through two shafts, and installation of an underground crusher plant which is largely automatic and designed for one-man operation. Pumping facilities are also being revised and expanded to handle the additional water coming in through connections with the adjoining Morning Mine which was permanently closed down late in 1953.

ILLINOIS-KENTUCKY

Uranium core drilling at Hicks Dome in northwestern Hardin County, Ill., by William A. Chenault and W. G. Reynolds, of Louisville, Ky., began March 2. Other groups also expected to start drilling operations immediately.

Definitely radioactive material in rock outcrops has been found, and samples have been forwarded to the AEC for chemical assay.

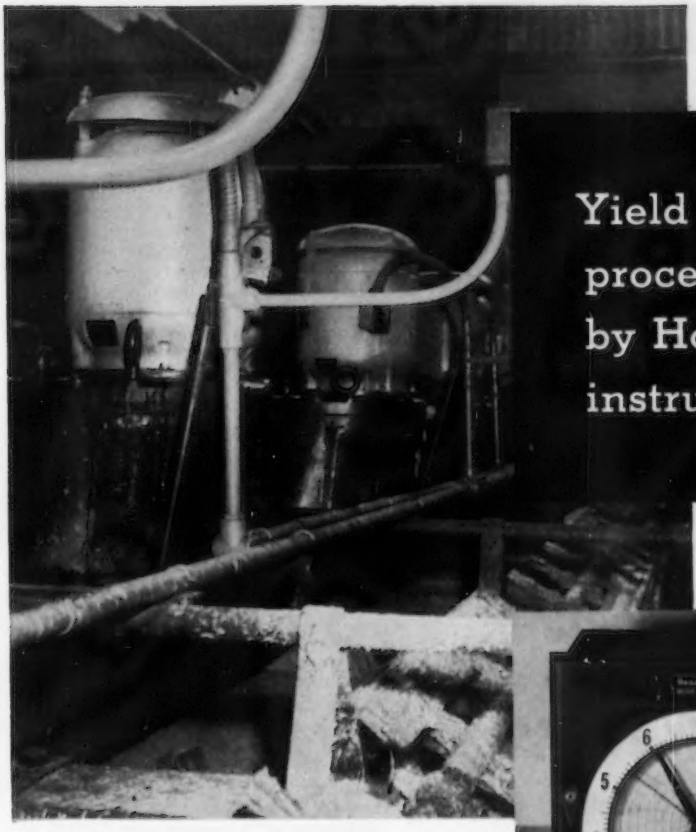
Geologists, miners, prospectors, promoters, and the merely curious are clambering over Hicks Dome, a geological anomaly formed by volcanic eruption, which lies close to the settlement of Hicks Branch and 13 mi northwest of Elizabethtown, the county seat.

Geologists of the Illinois State Geological Survey, Urbana, are making an investigation, and others, representing mining companies, are at the site.

The entire 1600 acres in the Dome, as well as acreage in the surrounding area, already are under lease.

At least four groups have acquired mineral rights leases and plan exploratory programs. Among the lessors are: Chenault and Reynolds; Boyce Moodie, Salem, Ky.; Willis Crider, Eugene Cruse, Allen Crider, K. D. Getman, Fort Watson, Cecil Craighead, Lyle Winn, Bill Beshear, all of Marion, Ky., William E. Styles, Union-town, Ky., Edward C. Steckler, Vincennes, Ind., and Slim Rea, of Texas.

Chenault, who started the first drilling operation at the Dome, believes the radioactive deposits lie between the surface and 1900-ft; and that samples taken in a 1952 operation below that depth, showing noncommercial value, were not from the main deposit.



Yield of ore beneficiation processes boosted by Honeywell instrumentation

Addition of caustic to flotation cells, at Noralyn plant of International Minerals and Chemical Corporation, is automatically regulated by ElectroniK instruments.

ADVANCED techniques of measurement and control are proving the key to greater efficiency and yield in a variety of ore beneficiation operations. For the diversified requirements of these processes, Honeywell offers a complete line of instrumentation. Thoroughly proved by years of industrial usage, the line includes:

For pulp density—Honeywell systems are applicable to the types of pulp and conditions of agitation, foaming and sanding usually encountered: hydrometer float, bubble tube manometer, or displacement type transmitter. All are available as remote transmitting systems.

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These and other Honeywell instruments are applied to your own processes by specialists who have years of experience in control technology. For a discussion of your requirements, call your local Honeywell engineer . . . as near to you as your phone.

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LOUISIANA

Freeport Sulphur Co.'s Chacahoula mine, 50 miles west of New Orleans, has begun producing sulphur. Development is part of a $25-million expansion program involving four new mines with productive capacity of more than three quarters of a milllion long tons per year.

Facilities include power plant for superheated water, compressed air and electric power for Frasch process mining, offices, storage and loading facilities and relay stations. Plant has normal capacity of 3-million gal of water per working day.

MINNESOTA

Oliver Iron Mining division led all other Lake Superior producers in 1954 shipments. It was followed by M. A. Hanna; Pickands, Mather and Cleveland-Cliffs Iron Co. This is the same order which resulted in 1953. In 1951 and '52, Pickands, Mather & Co. occupied second place with M. A. Hanna Co. in third position.

For 1954 the shipments of these four larger producers were: Oliver, 25,231,883 tons; Hanna, 10,360,610 tons; P. M. & Co., 9,149,277 tons and Cleveland-Cliffs, 5,131,514 tons. Total for the four companies was 49,873,284 tons, of which the Oliver produced more than one half. Shipments of the group were 81.61% of total Lake Superior area production of 61,111,967 tons, including Steep Rock Iron Mines, Ltd.

A second group of six companies is composed mostly of those smaller operators with direct furnace connections: Jones & Laughlin Minnesota ore division, 1,757,680 tons; all from the Mesabi range; Oglebay, Norton & Co., 1,637,669 tons, from the Mesabi and Gogebic ranges; Republic Steel Corp., 1,606,332 tons, from the Mesabi, Gogebic and Menominee ranges; Inland Steel Co. had 1,547,001 tons from the Cuyuna, Marquette and Menominee ranges; Steep Rock Iron Mines, Ltd., 1,156,654 tons, all from Steep Rock, Canada and Snyder Mining Co., 594,796 tons, all from the Mesabi range. These six companies contributed 13.58% of total shipments.

Last group consists of eight independent operators with 1954 shipments in the following order: Pacific Isle Mining Co., 531,124 tons, all from the Mesabi range; W. S. Moore Co., 508,915 tons, all Mesabi range; North Range Mining Co., 465,342 tons from the Marquette and Menominee ranges; Rhude & Fryberger, 464,828 tons, from Mesabi and Cuyuna ranges; Pioneer Mining Co., 461,535 tons, all from the Mary Ellen mine on the eastern Mesabi range; Zontelli Brothers, 233,802 tons, from the Mesabi and Cuyuna ranges; Haley-Young Mining Co., 144,892 tons, all Mesabi range, and the Charleson Mining Co., 128,113 tons, all concentrates from lean ore stock-pile at Virginia, Mesabi range. This group had a total of 2,938,551 tons or 4.81% of total shipments.

The Price Alone of CRD one-use bits can lower your drilling costs

. . . and they are made and backed by CLEVELAND Rock Drill

How do Cleveland CRD one-use bits save you money? It's just plain economics. You see, the price of CRD bits on an average, is less than one-half that of a multi-use bit. In fact, the price of a CRD bit comes close to matching the cost of reconditioning a multi-use bit.

So the price alone of CRD one-use bits can help you cut your drilling costs. But there are other reasons to use CRD bits, too.

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Lower Rock Drill Repair Costs — Because the CRD bit design reduces binding in the hole, there is less strain on the rotation parts of your rock drills. Rifle bars, rifle nuts, and chucks last longer. You get more drilling done at lower cost.

Since no special equipment is needed for reconditioning bits or threading rods, you owe it to yourself to try a can of CRD bits. They're ideal for roof bolting and for use in your stopes as well as in your headings. A short trial will give you first-hand information on the ability of these bits to cut drilling costs in your property, as they have in so many others.

Bulletin RD-29 gives detailed information. A copy is yours for the asking — just write for it.

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	1 5/16	Pink		1 1/2	Green
	1 3/8	Deep Green		1 5/8	Yellow
	1 7/16	Brown		1 5/8	White
	1 1/2	Grey		1 11/16	Black
	1 5/8	Maroon		1 3/4	Red
	1 3/4	Deep Blue		1 13/16	Blue
				1 7/8	Tan
				1 15/16	Plain
				2	Pink
				2 1/8	Maroon
				2 1/4	Aluminum

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See... Your local Haynes Stellite Dealer

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Minnesota *(Continued)*

Reserve Mining Co. shipment of 279,970 tons of taconite concentrate pellets in 1954 is about 34,000 tons more than was produced in 1953. In 1952, 12,861 tons were shipped. Erie Mining Co.'s taconite plant at Aurora shipped 184,314 tons in 1954 against 211,240 tons in 1953. Its first production was in 1949.

Oliver Iron Mining Division's Pilotac taconite plant shipped 360,363 tons in 1954, making it the largest producer of taconite concentrates last year. It shipped 104,464 tons in 1953, its first productive season. Total shipments from the three plants, including the 1954 season, have been: Erie, 704,531 tons; Reserve, 694,631 tons; Pilotac, 464,827 tons.

Oliver Iron Mining Division will close its Godfrey underground mine near Chisholm by May 1, R. T. Elstad, president of the U. S. Steel mining division said. Miners have already begun the removal of mining equipment from some of the working places in preparation for the shutdown of the property.

The mine is being closed, Elstad explained, because it has become uneconomical to operate under present conditions. The high cost of the ore, of which taxes is a substantial item, and the decline in the quality of the ore produced has made the continuance of operations not practicable.

Closing of the Godfrey marks the second underground mine Oliver has closed in the past six months. The Fraser, located east of Chisholm, ended its operations last fall because it, like the Godfrey, could not be economically mined.

MICHIGAN

Michigan's 1954 iron ore shipments, as compared to those of 1953, were reduced by more than 28%, while Minnesota took a loss of about 40%. New York State was unique in that it made a small gain over record setting 1953.

Four M. A. Hanna Co. mines in the Iron River district shipped a total of 1,651,127 tons. Of this total the Hiawatha furnished some 530,229 tons; the Wauseca, 481,886 tons; the Homer, 433,632 tons, and the Cannon—a new mine which is expected to be a large future producer—205,380 tons.

Hanna's Richmond mine open pit on the Marquette range produced 83,378 tons and 152,287 tons were shipped from the Wakefield mine stockpile on the Gogebic range.

An underground drilling program is being conducted at the Spies mine of the Cleveland-Cliffs Iron Co. the success of which will determine whether continued operation of the property is possible. The Spies shipped 101,368 tons in 1954. The mine employs about 80 men and is the only Cleveland-Cliffs operation on the Menominee range.

To complete the Osceola mine unwatering process of Calumet & Hecla, Inc., Calumet division, it was necessary to drive a 750-ft crosscut. Its completion in 25 days by a picked crew ended a three month delay in pumping operations. After unsuccessful attempts to open a valve outside a dam in a crosscut which connects the Osceola and Conglomerate lodes, it was decided to drive a new crosscut through the intervening rock. The 5 x 6-ft cut was begun on Dec. 16. Two miners, a scraper and a boss worked on each shift, and 25 round-the-clock days later the crews broke through into old Conglomerate lode workings. Nine days after the crosscut was completed, a 7½-ton, 2300-v cable, a 350-hp, 5,000 gpm submersible pump and 500 ft of 12-in water pipe had been lowered down the Osceola No. 13 shaft. The pump was dropped 405 ft below the water level and pumped water through the new crosscut to the Conglomerate lode and then to surface through the vertical shaft. This is said to be the largest unwatering project of its kind in mining history.

Inland Steel Co. is stockpiling ore at its Morris and Greenwood mines on the Marquette range; the Sherwood and Bristol mines on the Menominee range and the Armour No. 1 on Minnesota's Cuyuna range.

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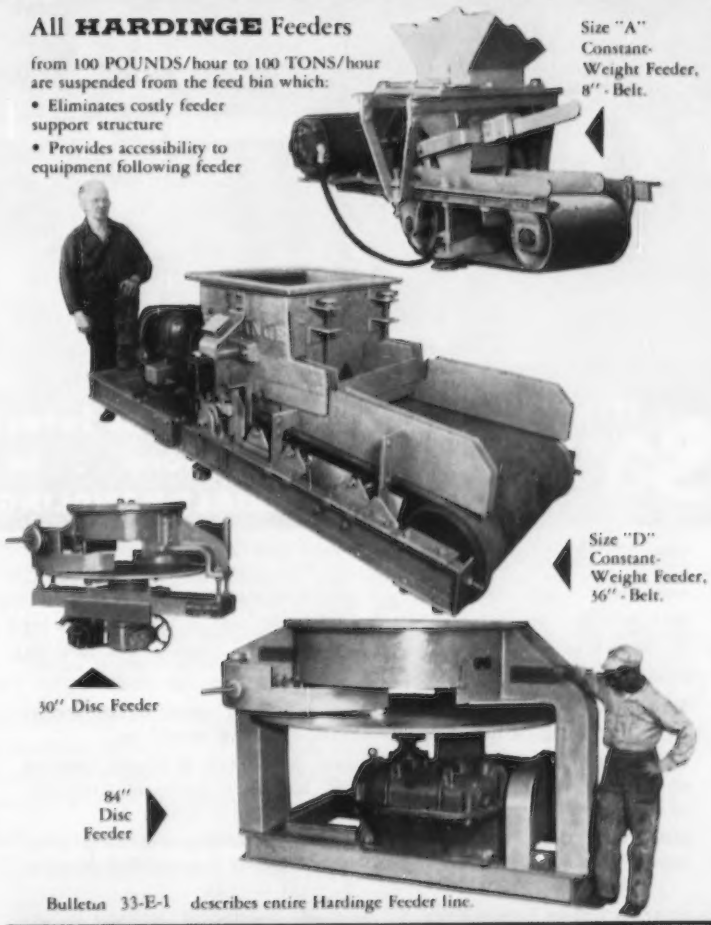

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Michigan *(Continued)*

Republic mine of the Cleveland-Cliffs Iron Co. at Republic which will mine and concentrate "jasper" is well along with its construction program. It will begin production in June or July of 1955 and is expected to operate at the rate of 400,000 tons per year. Company's Humboldt mine is already in production on similar crude ore and is designed to concentrate about 250,000 tons per year.

Humboldt made its first shipment in 1954: 153,738 tons. This was the first shipment of jasper concentrates from any Michigan mine.

MONTANA

Anaconda Copper Mining Co. has leased to Pioneer Corp. of Kellogg, Idaho, a 160-acre manganese prospect about 35 mi from the city of Missoula, near the rail-siding at Bonita. Bulldozer trenching and exploratory tunneling are planned during the coming summer.

Preliminary surface work by the Pioneer firm last year yielded 20 tons of hand-picked ore which netted the company nearly $500 in manganese settlements and disclosed the presence of silver and copper values.

Mineral King Mining Co. expects to undertake an extensive development program this year on new surface orebodies disclosed last summer on its Tarbor claims in western Mineral County. Application has been filed with the Spokane office of the DMEA for 50% Federal assistance on the project.

The new ore disclosures are on a vein structure which has been traced for 5,000 ft on the surface. One is about 1600 ft higher on the mountain than the other, and both show consistent values of from 4 to 5% lead, with 1 oz silver for each per cent of lead.

Plans are to work the upper exposure by open-pit methods and the lower exposure through tunnel workings.

Minerals Engineering Co. has placed in operation a second 400-ton milling unit at its Glen tungsten concentrator. Mine production at its Brown's Lake open-pit operation is being expanded to 20,000 tons a month.

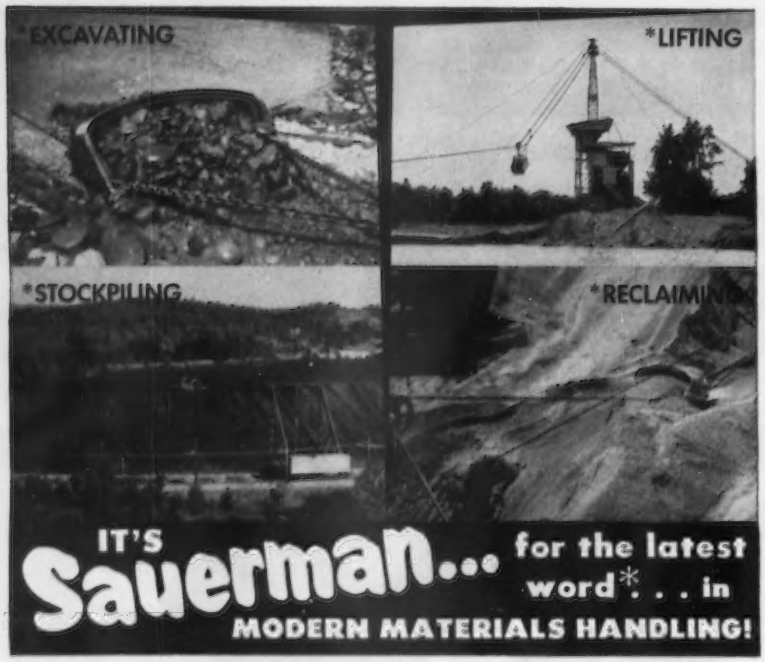
NEVADA

Uranium ore in 50-ton lots is being shipped by rail from the Big M Co. property in the Kinkead district near Hawthorne. Shipments are being made to Salt Lake City. Railroad cars are loaded at Thorne which is not far from the mine.

Uranium ore mined in the Atlanta district of Lincoln County will be shipped to Salt Lake City as soon as winter road conditions make it possible. Ore is being stockpiled by the owners of the mine, James G. and Philip Hulse, both of Pioche, and L. L. Hezzlewood and Larry Parks, of Las Vegas. More than 100 tons of ore are now ready for shipment.

Standard Slag Co. of Youngstown, Ohio, has taken over the Betty O'Neal mine 13 mi south of Battle Mountain from M. S. Fisher of that town. Transfer was by lease with option to buy and a bond posted. R. O. Jones, western manager for Standard Slag, announces that the company will conduct geophysical exploration work which will be followed by diamond drilling. The Betty O'Neal, which was operated from 1919 to 1931 under management of N. H. Getchell, produced more than $8-million worth of silver during those years.

New mill recently constructed by Uranium Mines Inc., at its Linka Tungsten property in Smoky Valley is now in operation handling 150 tpd. Living quarters just completed provide facilities for 40 men. Ore is being taken from the 150-ft level from which pumps are removing 600 gpm. M. N. Shaw, manager of the Linka property, has announced plans to shrink-stope the orebody from the surface to the 150-ft level and to run long hole blasting and scram drift loading from the 300-ft level. The mine's orebody has exceeded all expectations in both size and grade, according to Shaw, and diamond drilling and underground operations into virgin territory are each day showing new tonnage.



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C. H. Ward, mining engineer at Ogden, has leased the Errington-Thiel properties 65 mi southwest of Wells. The holdings include the Ruby Mica property and adjacent claims. The deal includes an option to purchase for $500,000. Ward says development plans at the site call for air-float separation of mica, beryl, autunite, lithium and garnet. Minerals are found in extensive dikes on 50 claims controlled by Errington and Thiel, both mining men living in Elko.

NEW MEXICO

Utah Construction Co. is planning to build a petro-chemical plant in conjunction with a steam-electric plant at Fruitland, 13 mi west of Farmington in the San Juan Basin.

Frank M. Keller, vice president, said the plant is planned in connection with core-drilling of 88,000 acres west of Fruitland. Estimated cost was not disclosed.

Utah Construction holds a lease from the Navajo tribe giving it the right to develop coal, uranium and other minerals.

Socorro Uranium Corp., developing 22 claims on Ladron Peak south of Belen in Socorro County, has shipped 21 tons of uranium ore assaying .50% or more to the mill at Grants. The shipment reportedly was hand-picked.

Calumet & Hecla, Inc., has launched a $300,000 drilling program on Mesa Top, 25 mi west of Albuquerque. Calumet & Hecla is working under contract with Canoncito Uranium Corp., which holds prospecting permits on the Indian-owned land.

Charles A. Steen's Moab Drilling Co. is completing contracts with Cal-U-Mex Uranium Corp., Albuquerque, N. M., for exploration on about 20,000 acres of New Mexico school sections controlled under prospect permit by the latter firm. It will be one of the few ventures by Steen and his associates outside of the Big Indian district south of here.

Moab Drilling would put up cash for the prospect, receive from 60 to 75% interest in any ore discovered.

$3-million uranium mill, built by Navajo Uranium division of Kerr-McGee oil industries on the Navajo Indian reservation, expected to be in full operation by March 1. Mill reportedly includes machinery and processes new to uranium milling in the U. S., which produce a yellow cake concentrated U_3O_8 and "red cake" concentrated vanadium oxide.

Navajo Uranium is producing some of the ore in the Lukachukai district and will process ores from other companies. Clyde E. Osborn, operations manager, says mill will eventually employ about 100 men, 40 of them Navajos trained as laboratory technicians.

Joint undertaking by Freeport Sulphur Co. and Pittsburgh Consolidation Coal Co. will produce potash from a deposit near Carlsbad under the name of Na-

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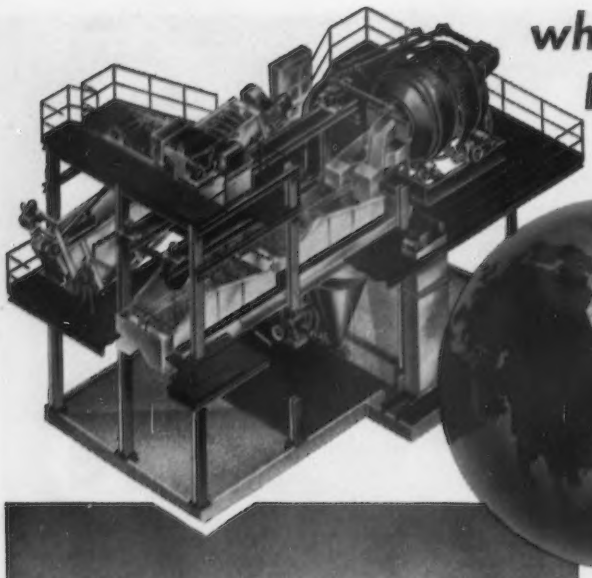

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New Mexico *(Continued)*

tional Potash Co. Richard C. Wells, Freeport vice president and controller, will head the new firm. Project, calling for estimated outlay of $19-million, will produce potash containing equivalent of approximately 250,000 tons potassium oxide per year.

Area to be worked is about 32 miles east of Carlsbad, where Freeport discovered the deposit in exploratory drilling in 1949. Some 60 core tests, involving 100,000 ft of drilling, have been completed.

NORTH CAROLINA

Nipissing Mines Co., Ltd., of Canada, has announced plans to sink a 1150-foot shaft into the old Ore Knob copper mine 9 mi east of Jefferson, N. C., to determine whether there is enough copper still there to justify reopening.

Diamond drillings conducted last year located deposits which apparently are of mineable proportions, but the results are considered inconclusive. According to Nipissing, the drillings showed about 1,219,700 tons of mineable ore, averaging about 3.09% copper, .09% zinc, .036% cobalt, and 14.29% sulphur, with .008 oz gold per ton and .33 oz silver.

Vein, the drilling indicates, is between four and 42 ft wide, about 3300 ft long and between 200 and 550 ft in depth, but it was pointed out that "ore testing will have to await further underground development of the orebody."

Company already has paid $2-million in options on Ore Knob and adjoining property, totaling 2,051 acres, and should it follow through would pay a total of $192,746 for mining rights, including surface rights to 200 acres on which it would erect mining equipment. Surface rights on 1,232 acres could be had for an additional $100,000.

SOUTH DAKOTA

Improvement in stoping methods and new crushing and grinding equipment at Homestake Mining Co.'s gold mine at Lead helped offset a higher wage scale and higher costs, the company reported in announcing a 1954 net income of $4,489,648.

During 1954 the company milled 1,485,226 tons of ore, an 8.5% increase over 1953. However, bullion output was only $158,000 higher since value of gold recovered per ton declined from $13.34 to $12.40.

Cost per ton for mining was the same as in 1953, while milling cost was 15c lower.

A deep level mining program is under way, involving completion of two existing major shafts for hoisting from the 4850 level. Access drift on the 4850 level to the site of the new underground shaft had reached turn-off point to the hoist room location by end of January. By end of this year, general manager

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South Dakota *(Continued)*

A. H. Shoemaker expects to start sinking below the 5,000 level.

Ore reserve as of Jan. 1, 1955 was 17,587,200 tons, 850,050 less than the previous year. Further reduction is anticipated during 1955, since the deep level program must be completed before more ore can be blocked out.

UTAH

Officers of the new Federal Uranium Corp of Nevada, controlled by financier Floyd Odlum, were named last month, following announcement that 10 companies had merged to form the new corporation.

President of Federal Uranium of Nevada will be W. D. Nebeker, Salt Lake City investment broker. He also will be chairman of the board. Other officers are Lester S. Harrison of Kellogg, Idaho, president of U & I Uranium Co., vice president and director; and D. Howe Moffat, secretary-treasurer of Federal Uranium of Utah, secretary-treasurer and director of the new firm. Other directors will include Melvin D. Reukhaus, Albuquerque, N. M.; William J. Cayias and Reed W. Brinton, both of Salt Lake City; Robert D. Daniel of Grand Junction, Colo.; H. Lyle Jesstley of Canada and Paul T. Walton, Salt Lake geologist.

Publicly held companies involved in the merger are Federal Uranium Co., a Utah corporation; U & I Uranium, Inc.; Kentucky-Utah Uranium Co.; Utida Uranium Co., Howell Mining Co.; Santa Fe Uranium Co.; Interstate Uranium Co., and Western States Uranium. Also merging with the new company are the privately-owned Fourteen Group, Inc., and Uranium Prospectors, Inc.

The new Federal of Nevada will have an authorized capitalization of 7,500,000 shares with a par value of 50c a share. Merger reportedly called for issuance of about 5,453,000 shares, with the rest held for later issuance or acquisition of other companies and properties.

Odlum representatives were reported working on other merger possibilities.

Consolidation will reportedly have no affect on the agreement which U & I Uranium recently concluded with Hecla Mining Co., Wallace, Idaho to develop the orebody and bring it into production. Hecla crews are already on the job and expect to start sinking a three-compartment vertical shaft by the latter part of April. It will be pushed on a three-shift basis, 6 days a week, and the depth objective of 600 ft is expected to be reached before Aug. 1.

U & I Uranium is the operating company for six Kellogg firms—Caledonia Silver-Lead Mining Co., Nancy Lee Mines Inc., New Era Mines Inc., Coeur d'Alene Silver Giant, Inc., Signal Mining Co., and Silver Bowl Inc.—each of which owns 1-million of the U & I firm's authorized 10-million shares.

Among recent uranium company mergers, Sterling Uranium Corp. took over operation of four other Utah outfits—

Red Man Uranium, Atomic Uranium, Utah-National Uranium Mining Corp. and Trans-World Uranium. Through the merger, Sterling acquired ownership or control of 4,200 acres of uranium claims in Utah, Colorado and Wyoming.

Temple Mountain Uranium Co. of Salt Lake City joined with Consolidated Virginia Mining Co. of San Francisco in acquiring control of the Four States Uranium Co. of Grand Junction, Colo.

Milton H. Love, director of the Utah Securities Commission, estimated in Salt Lake City that Utah uranium companies received from $60-to 70-million for ore shipped in 1954. This year, he predicted, the figure should reach $125-million.

Love said state records show that 31 Utah uranium firms actually have mined and shipped ore. This represents about 25% of the companies registered with the securities commission, he said.

Biggest royalty payment in the history of the uranium industry was received by the State of Utah in February. Consolidated Uranium Corp., Inc., with holdings on state lands in the Big Indian district, paid the state $26,117.29 for the quarter ending Dec. 31, 1954.

Nev-Tah Oil and Mining Co. has announced a $900,000 purchase agreement for the Stocks-Gramlich uranium mines in the La Sal district of San Juan County.

Standard Uranium Co. plans production of more than 100 tons of uranium ore weekly from its properties in the Big Indian District, San Juan County.

The firm is now producing at rate of 40 tons daily. But with delivery of Gismo that output will be hiked.

Shipments go variously to Moab sampling station and to the Monticello mill.

Lisbon Uranium Co., 67% controlled by affiliates of Floyd B. Odlum's Atlas Corp., has purchased interests of Robert M. Barrett in the Big Indian District, San Juan County, for $3½-million.

The firm also announced recovery of high grade ore on claims near the Barrett holdings. Extent of the deposit is not known as yet. The Barrett claims, numbering 43, are on north end of Big Indian District. Lisbon purchase also included Barrett's royalties under the Little Beaver Mining Co. lease operated by Homestake Mining Co.

Air Fleets, Inc. obtained the Barrett properties under assignment to Lisbon. Air Fleets, with Wasatch Corp. and San Diego Corp. all Atlas Corp. affiliates, controls Lisbon.

Consolidated Eureka Mining Co. reports discovery of a new lead-silver-copper contact zone at its Eureka County, Nev., mine in eastward drifting around the main orebody.

The ore discovery cannot be evaluated quantitatively at this time, according to Sherman Hinckley, general manager of the company.

It is off the 320-ft level, about 27 ft into the Hamburg formation.

H. W. Balsley, veteran uranium figure of Moab, has sold four uranium claims

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Utah *(Continued)*

at juncture of East and South Canyons, in Big Indian District, San Juan County, for $100,000. Sale was made to Ben D. Browning, Salt Lake City and Charles Garlett, Moab, who represented an undisclosed California syndicate. Payment was in cash. The claims were mined for vanadium as early as 1942.

New Park Mining Co., operating lead-silver-zinc mines at Park City, immediately east of Salt Lake City, reports net profits of $107,371 for 1954, compared with $39,456 for a like period in 1953.

The report was made to American Stock Exchange, Salt Lake Stock Exchange and San Francisco Stock Exchange on which markets shares of the firm are listed.

A more detailed annual report will be made available later to shareholders.

In the exchange summary, W. H. H. Cranmer, president, noted that investment of $10,320 in Lucky Mc Uranium Corp., which he heads, made by New Park early in 1954 now had a market value (on March 3) of $732,500.

Brigham Young University has been selected to receive a four-year research grant or $50,000 from Kennecott Copper Corp., it was announced by L. F. Pett, general manager of the company's Utah Copper division.

New grant doubles previous grant to the University and is also for metallurgical research.

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WASHINGTON

Gold Bond Mining Co. is planning to resume stoping operations on its Olympic claim in the Blewett district this spring. It will also run a short tunnel to open the Ivanhoe vein. Frank Lilly, Spokane, president, informed stockholders that the company is trying to interest producers of stainless steel and other nickel alloys in a nickel deposit at the Chelan County property. It is thought the deposit is similar to the Oregon nickel deposit, near Riddle, where Hanna Smelting Co. is producing nickel. A lower level at the company's Pole Pick gold mine was opened.

Howe Cound Co., which operates the Holden copper-gold-zinc mine in the Lake Chelan district in north central Washington, reported that its 1954 gross sales were $22,714,637 for a net of $787,800, compared with $23,231,389 for a net of $1,014,195 in 1953.

J. S. Huckaba, Spokane metallurgical engineer, who founded the Contract Milling Co. which has been concentrating ores at Mitchell Mining Co.'s claims near Butte, Mont. has sold his interest in the firm. The Contract company is now held almost entirely by Mitchell Mining Co.'s owners and Spokane men. Mine, which had been closed since mid-December, has been reopened on a one-shift basis with production expected to be about the 1,000-ton average of previous months.

Goldfield Consolidated Mines Co. of Reno, Nevada, is operating its 400-ton concentrating plant near Aladdin, in Stevens County at about half capacity waiting for higher zinc prices, according to Truman Higginbotham, manager. Development ore from the upper levels of the Deep Creek mine is going into the mill. Thirty men are employed at the mine and mill. The company's open-pit Anderson zinc mine has been closed for about 3 years.

Grandview Mines, which operates near Metaline Falls, reported a net loss of $26,214 in 1954, compared with a net income of $11,132 in 1953. Low metal prices and a strike which lasted about 6 months were given as causes. One of its two DMEA contracts resulted in the discovery of about 200,000 tons of low grade zinc ore.

King Silver Mining Company, of Wenatchee, has recently opened a silver deposit at the lease on private holdings west of Oroville by shaft at 35-ft depth.

Values are expected to increase from 30-oz ore with greater depth. Values exist here as sulphides in a quartz matrix.

Wm. H. Gaines is president and general manager, with George E. Fales, of Cashmere, as consultant.

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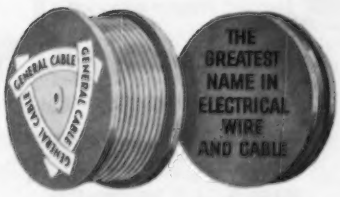

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Washington *(Continued)*

Sherman Creek Uranium Mines, Inc., has been formed by five Washington State men to develop 29 mining claims in the Sherman Pass area of Ferry County. Company, incorporated for $600,000, is privately financed and intends to bulldoze and diamond drill claims during the spring.

One of the incorporators, Burton G. Fowler of Republic, said the claims cover an area where uranium is believed to exist in both pegmatite dikes and veins. Assays of surface material collected during mid-1954, said Fowler, indicated up to .12% uranium oxide.

Company directors are Fowler; Arthur J. Lane, Republic; R. R. Imbody, Ritzville, Wash.; and William Gail and Paul E. Morrison of Seattle.

Alpine Uranium Co. has 10,000 tons of 3% copper ore stored at its Deer Trail Mine near Fruitland ready for milling. James W. Lower reports the company has been milling base ore from its dump but recently began strip mining.

The firm developed the copper mine for diversified production, and has stripped an area of approximately 18,000 sq ft, with the ore running 15 to 18 ft thick. Mineral more than 50 ft underground will be mined from underground workings. The firm has rehabilitated 3,000 ft of tunnels and shafts, some as deep as 400 ft.

WYOMING

Proposals from four companies interested in building a uranium processing plant in the Black Hills area are being considered by the AEC, and AEC spokesmen said a contract was expected to be completed "in the near future."

Both Wyoming and South Dakota are seeking the processing plant. Newcastle, Wyo., and Edgemont, S. D., are considered likely sites.

Taylor Belt, chief of industrial development for the Wyoming Natural Resource Board, said discovery of rich uranium ore in the Rounds property in Barlow Canyon should be a factor in Wyoming's favor in the competition for the mill. Belt said ore found by Don Rounds had assayed at 7.5 and 7.06% uranium.

Shipment of ore from the Nugget Coal & Timber Co. uranium mine 50 mi north of Hanna started in February. Nels A. Swenson is president and general manager of the company.

Standard Uranium Co. of America announced discovery of three uranium deposits on its property on the Natrona County side of the Gas Hills. Roger Evans, general manager, said assays showed uranium oxide percentages of .56, .58, and .8.

Mountain Mesa Uranium Corp. has purchased 50 claims in the Fremont County area of the Gas Hills from Sam Day, oil and uranium promoter from Fort Collins, Colo. Sale price was $1,000

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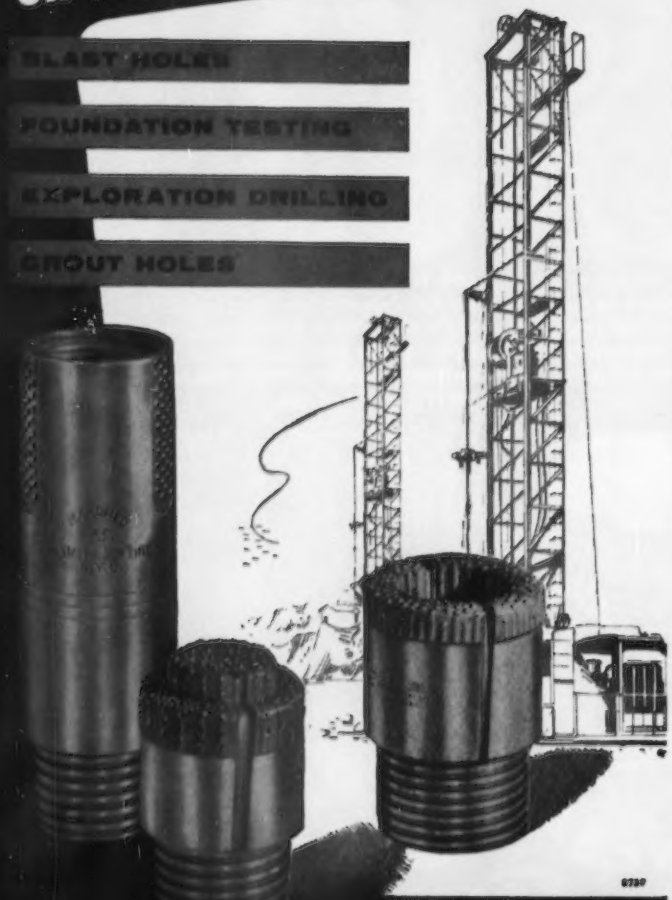

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Wyoming *(Continued)*

a claim, plus ore payments that might total as much as $150,000.

Bids for 8,000 ft of core drilling in the Gas Hills and Green Mountain areas of Fremont and Natrona Counties were to have been opened by the AEC in Denver last month.

Mid-Continent Exploration Co. has announced plans to build a pilot mill near Sundance preparatory to development of a multi-billion-dollar ore reserve in the Bear Lodge mountains.

Mid-Continent said deposits in the area are expected to yield more than $2.7-billion worth of rare earths, thorium, manganese, uranium and other metals.

The company now has mineral rights to more than 4,000 acres in the Bear Lodge mountains, north of Sundance in northeastern Wyoming. Radioactive zones 5,000 ft long have been traced by stripping and trenching operations.

Sun Uranium Corp. is concluding negotiations with Standard Ore and Alloys Co. for a 50-50 exploration and development of 126 claims held by Sun in Gas Hills District, Fremont County.

Mountain Fuel Supply Co., natural gas utility serving Utah and southern Wyoming, has entered the western uranium search.

President W. T. Nightingale confirms the company has taken option on "several hundred" uranium claims in southern Wyoming. But he says the utility to date has found only very low grade ore (.01 U_3O_8) and that "quick as we take up an option, drill the claims, we relinquish our holdings when they don't pan out."

The firm confirmed that it has under present option 100 claims in the Lost Creek area of Sublette County, Wyo.

IN CANADA

BRITISH COLUMBIA

A national controversy has reportedly developed between federal government of Canada and practically the entire mining industry in Yukon Territory and British Columbia in wake of attempts by Department of Northern Affairs and Natural Resources at Ottawa to alter drastically existing statutes covering vital phases of Yukon mining industry.

Almost the whole segment of Yukon mining industry, bulwarked by British Columbia and Yukon Chamber of Mines, has opposed the report of Col. George E. Cole of Winnipeg, who as government-appointed agent, conducted personal survey of the Yukon and urged changes in tradional provisions governing staking, surveying and leasing of mining claims in the Yukon.

Spearheading the protest, Chamber of Mines has petitioned Federal Government to retain the existing "Yukon Quartz Mining Act" with only minor amendments.

A detailed brief opposing the Cole Report, prepared by Dr. W. V. Smitheringale, well-known Yukon geologist, has been enthusiastically endorsed by the B. C. Chamber.

Summarized by the Chamber, the five main proposals in Col. Cole's report are:

(1) that to a large extent the existing Yukon Quartz Mining Act be eliminated, to be replaced by a series of regulations;

(2) areas in Yukon Territory should not be withdrawn from ordinary staking to grant reservations or concessions;

(3) a system of 4-post staking (similar to that now in effect in Eastern Canada) should replace the existing 2-post, single-line method now in effect in Yukon and British Columbia;

(4) a time limit should be set within which a claim owner must have his mineral claim surveyed;

(5) a claim holder should be compelled to take out a lease within a "reasonable" time. (Col. Cole had suggested a limit of 10 years after a mineral claim had been recorded as the maximum period.)

Chamber of Mines said that 95% of mining people, including prospectors and scouts in the Territory are strongly opposed to the recommendations in the Cole report, with exception to the one pertaining to granting of concessions.

Despite the protests, correspondence between B. C. Chamber and Hon. Jean Lesage, Minister of Northern Affairs and Natural Resources in Ottawa, the Federal government has indicated it intends to implement Col. Cole's findings.

Northwest Ventures Ltd. of Vancouver is rapidly becoming active on many mining fronts with international implications.

Last year it granted an option to Newmont Mining Corp. to purchase a group of 49 claims on Gravina Island, 12 miles south of Ketchikan, Alaska. Purchase price for this copper prospect is $20,000 cash and 750,000 shares in a 3-million-share company to be formed if option is exercised.

Last summer Northwest staked a further six claims near its copper prospect on south side of Leduc Glacier, and these claims will be given attention.

Recently the company took an option and since has staked 44 claims covering interesting copper prospects near Keefers in Fraser Valley.

Now Northwest announces it is ready to proceed with magnetometer survey. Second series of assays from Keefers property indicates values of 1.63 copper; 2.39 nickel and 16% cobalt.

Northwest also has acquired a 50% interest in a Utah company holding several claims, and drilling for uranium prospects is reported now under way.

Northwest holds one-third interest in Pelly River Explorations along with American Standard and Pioneer Gold. Pelly River has been active for past two seasons in southern and central Yukon.

Jack Ross, general manager of Granby Consolidated Mining Co., has reported that ore reserves at its Copper Mountain mine are dwindling fast and unless price of copper rises to 35 or 40c, working the mine will not be economical beyond September.

ONTARIO

Shaft sinking has been completed at Beaucage Mines columbium-uranium prospect on Newman Island, Lake Nipissing, near North Bay. Initial objective of 450 ft was reached on schedule, and first level is now being established at the 400-ft horizon. Development work is expected to provide 5,000 tons of potential ore quickly for use in the pilot mill, construction of which was started last month.

New staking rush has developed in the townships west of Timmins, where hundreds of claims have been staked in search of copper. Area has long been known as favorable ground for the red metal, and saw some production from the Kamiskotia mine in World War II; but there had been little subsequent activity until recent weeks. Leading company in the new rush is Broulan Reef Mines, Porcupine gold producer, which has acquired 150 claims covering 2.4 miles of the favorable structure; geophysical work has been started.

Steep Rock Iron Mines shipped 1,156,654 gross tons in 1954, 145,000 less than in

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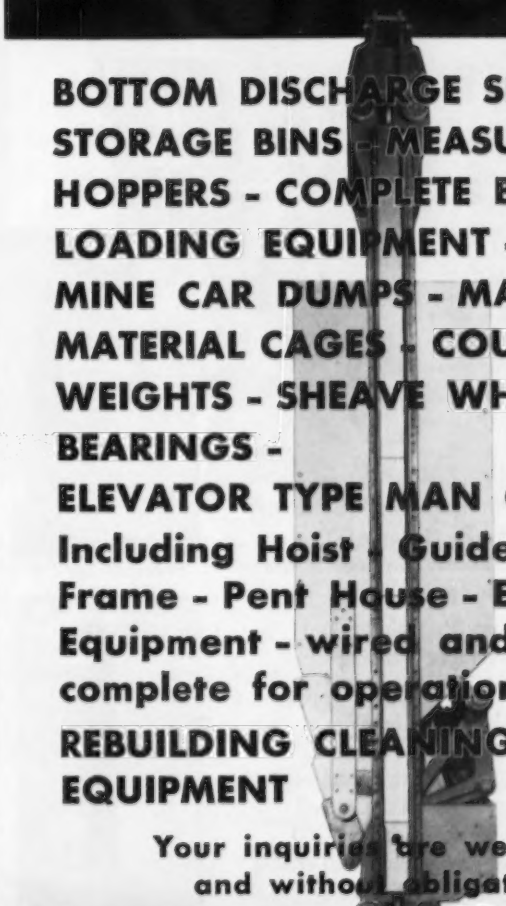

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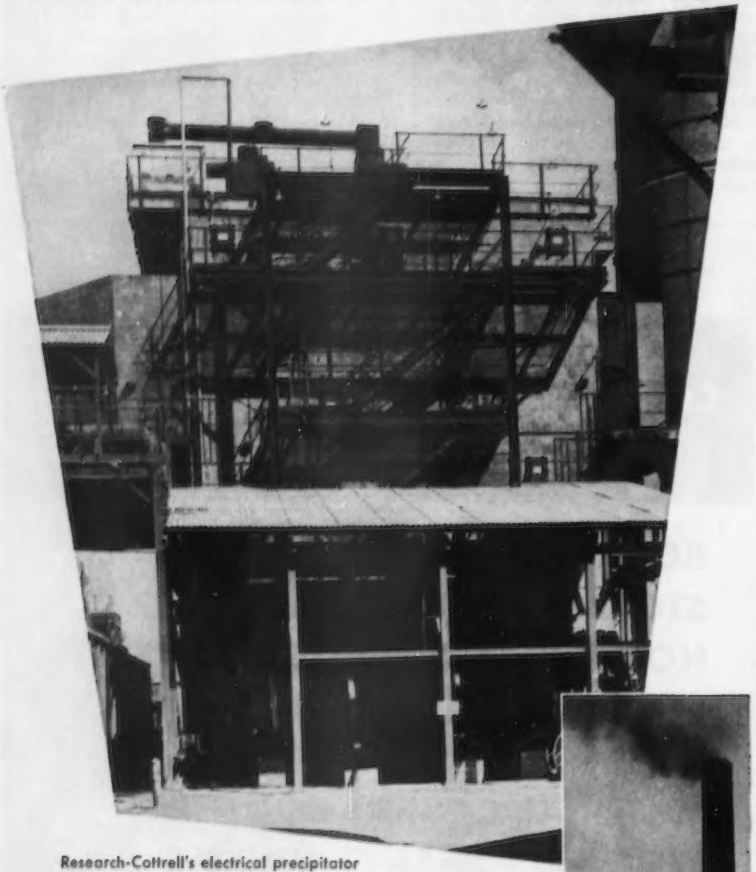
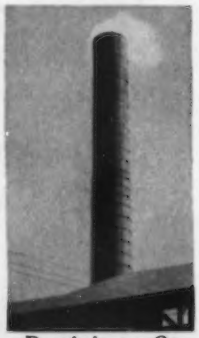


Research-Cottrell's electrical precipitator installation at the Palmerton, Pa. plant.

Precipitator Off



Precipitator On

The two photographs (right) show the results of this Research-Cottrell installation. The smoke in the picture at the top (Precipitator Off) consists of dry dust and fume entrained in the zinc ore sintering machine gases.

The picture at the bottom (Precipitator On) shows nothing but water vapor escaping from the same stack.

If you have a fume problem that involves recovering valuable materials that are going up the stack or combating a smoke nuisance, get in touch with your nearest Research-Cottrell representative. His experience with over 300 roaster and metallurgical precipitators will enable him to advise you on the most effective—and economical solution to your problem.

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Ontario *(Continued)*

1953, according to Cyrus Eaton, chairman of the board. However, net profits rose by $800,000 to $4,251,180, he said. If present capacity of 2.75-million tons are sold in 1955, Eaton observed, that would mean profits of $10- to $25-million and would insure the company's first dividend next year.

Mr. Eaton observed, however, that selling that much ore is the major immediate problem. About 10% of the ore is lump ore, which finds ready sale at a $1 per ton premium.

Two mines are currently in operation, with two other mines in the development stage and due for 1956 or '57, that will raise output, Eaton said, to 5.5-million tons of 53 to 54% iron content ore per year.

Inland Steel's lease, which calls for 3-million tons ore production annually, is one to two years away.

Eaton observed that Steep Rock ore, one day's lake shipping time nearer Lake Erie ports than Duluth loaded ore, is in an enviable price position, on a unit price basis, with any Lake Superior area ore, even in its underground operation.

Geco Mines, big copper-zinc pioneer of the Manitouwadge area, is making good progress toward production. Work is well along on the highway and two railroads, and a start has been made on the townsite. A 5-compartment shaft has been started, with 1500 ft as the first objective, and work is well advanced on the adit which will provide first ore for the mill. Slated for production in 1957, the initial milling rate will be 3,300 tons daily.

At Steep Rock Lake, Caland Ore Co., subsidiary of Inland Steel Co., is planning to dredge the east arm of the lake to mine high-grade iron ore. Two dredges, largest of their kind in the world, were to be ready for testing this month, with dredging to start on a regular basis in May. Dredging is to be done under contract by Construction Aggregates Corp. of Chicago; it will involve the removal of 160 cu yd of fine clay that overlies the orebody on the bed of the lake. Schedule calls for first production in 1960, at estimated preproduction cost of $50-million.

New east orebody being developed by New Dickenson Mines, also in Red Lake, looks like the richest deposit opened in the mine to date.

First opened on the 8 level, ore has been drifted for a length of 216 ft at that horizon, showing an average by muck sampling of 0.63 oz gold per ton across drift width. Its upward extension has been located on the 7 level with width and grade similar to those of the 8; and its apparent extension has been picked up by drilling on the 5 and 6 levels.

Algom Uranium Mines is assured of funds with which to place its two Blind River properties in production (at 3,000 tons per day in each case) through a financing deal with a group headed by

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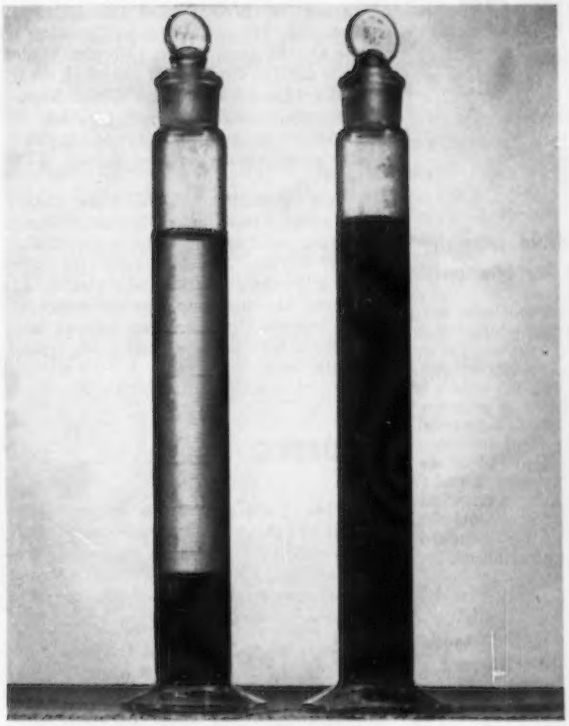

SEPARAN 2610 IMPROVES SETTLING RATE. The cylinder on the right shows untreated ore pulp containing 15% solids. The cylinder on the left containing the same pulp has been treated with .03 lb. SEPARAN 2610 per ton of dry solids. The picture was taken 30 seconds after addition of SEPARAN 2610 and agitation.

SEPARAN 2610 IMPROVES FILTRATION RATE. Filter above shows thin cake formed by untreated material. Filter below shows thick cake collected in the same length of time using SEPARAN 2610. This heavy, porous cake is much lower in moisture than the untreated material.

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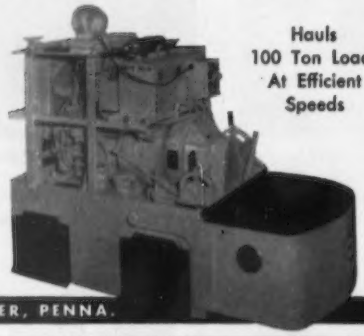

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Ontario *(Continued)*

Rio Tinto Co. Total money involved is $57.6-million, with Quirke Lake mine to start milling in 1956, Elliott Lake mine in 1957. Basis for the deal is the company's contract with Ottawa for the purchase of uranium concentrates to a total exceeding $200-million.

Blind River area continues to be Canada's most prolific source of exploration news. New companies to start work recently include Pardee Amalgamated Mines, drilling on the former Aquarius ground; Bunker Hill Extension Mines, drilling on claims in Striker and Mack twps.; Bracemac Mines, drilling on 18 claims in the Quirke Lake sector; Conecho Mines, with drilling contract let for work on its Quirke Lake claims; and Cusco Mines, formerly Goodfish Mining Co., but reorganized during the winter to explore a group of claims in the Agnew Lake section.

Among companies with work further advanced, Consolidated Denison Mines is making good progress, and is considering shaft sinking. Widely spaced drilling on the company's Quirke Lake claims, adjoining Algom's ground on the southeast, has indicated two uranium-bearing beds at depth with thickness and grade typical of the area.

QUEBEC

Quebec Copper Corp. is deepening its shaft to open a block of three new levels below the 1100-ft horizon, following completion of depth drilling which showed a number of excellent intersections to the 1300-ft horizon.

Another big asbestos mill is planned for the Eastern Townships area, Quebec Asbestos Co. having decided to put a 3,000-ton plant on the big orebody discovered last year 3.5 miles from the original mine, which is now nearing the end of economical open pit operations.

New mill will start production in the fall of 1956, and will have at least 50-million tons of ore on which to operate. Quebec Asbestos Co. is a subsidiary of Phillip Carey Manufacturing Co., of Cincinnati, and the new mine will be operated by a new subsidiary, Carey Canadian Mines. Estimated cost of bringing the property to production, including new housing, power, and transportation facilities, is estimated at $8-million.

Iron Ore Company of Canada is readying a third open pit mine for production at Schefferville, and will have it ready for mining when shipments resume this spring, During 1954, with production starting at the end of July, IOCO mined 2.8-million tons and shipped 1,781,453 tons down its railway to the port of Seven Islands on the St. Lawrence River.

In 1955 it is planned to raise shipments to 6-million tons.

Details of a plan to amalgamate Illinois Zinc Co. with Canadian Javelin, Ltd., and

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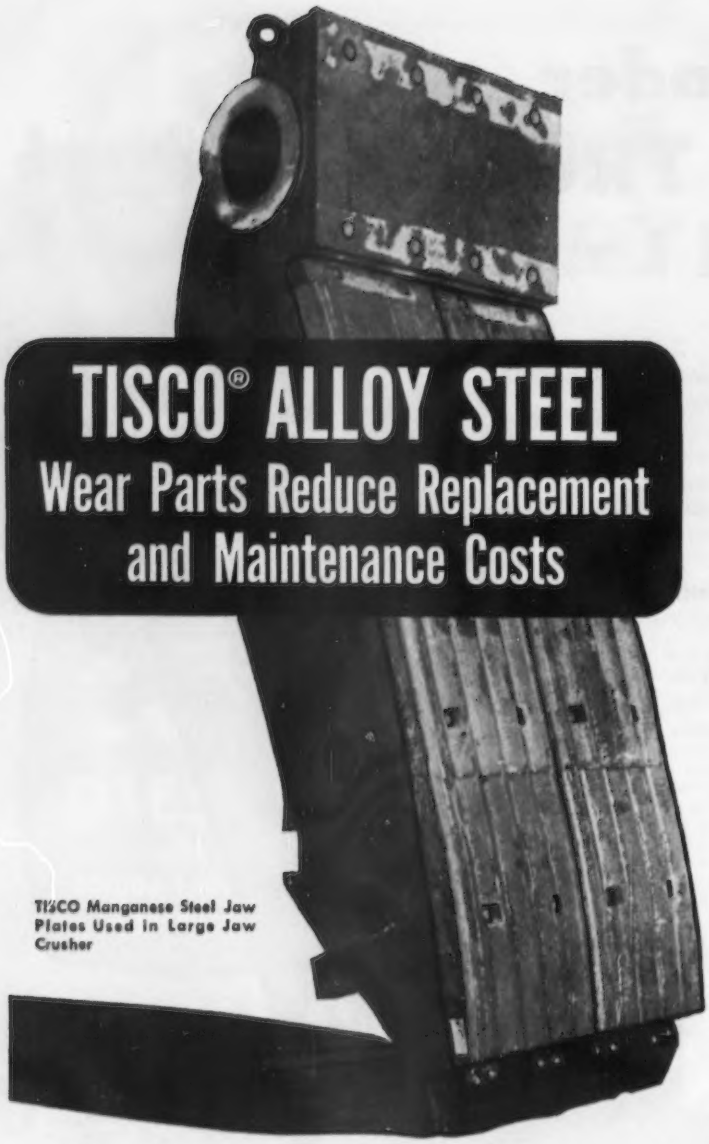

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Another useful alloy is TISCO 23-Y, a heat hardenable medium manganese chrome molybdenum steel of excellent abrasion resistance but only fair impact qualities. Hardness can be controlled between 300-500 Brinell. It is widely used for ball and rod mill liners, bushings and similar applications.

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Quebec *(Continued)*

Boon-Strachan Coal Co., Ltd., were announced by Morris Blumberg and John C. Doyle, chairman of the boards of the U. S. and Canadian companies. Illinois Zinc is an 85-year old producer of strip and sheet zinc with mining interests in New Mexico and Arizona. The Canadian companies have extensive iron ore and titanium properties in Labrador, Quebec and Chile. Plan will be presented to shareholders of the companies concerned as soon as a meeting can be arranged.

Amalgamation calls for acquisition of all assets of the Canadian companies by Illinois Zinc in exchange for stock in the U. S. company which will vest the dominating interest in the shareholders of Canadian Javelin. Company name will become Illinois International Iron and Zinc Corp. Boon-Strachan will act as operating and sales company in the new set-up.

Canadian Javelin's best known asset is the Lake Wabush iron ore deposit in Labrador. Internationally recognized iron ore experts and Newfoundland government geologists have confirmed the company's estimate of over 1-billion tons of shipping ore of 65% iron.

Other Canadian Javelin assets include a titanium property in Quebec, a foundry near Montreal, and producing mining companies in Chile. The titanium deposit on the Saguenay River contains 30-million tons of proven commercial ore and is situated in close proximity to deep water docks constructed by the government of Canada. The Beaver foundry at Joliette, Quebec, has been in operation since 1850.

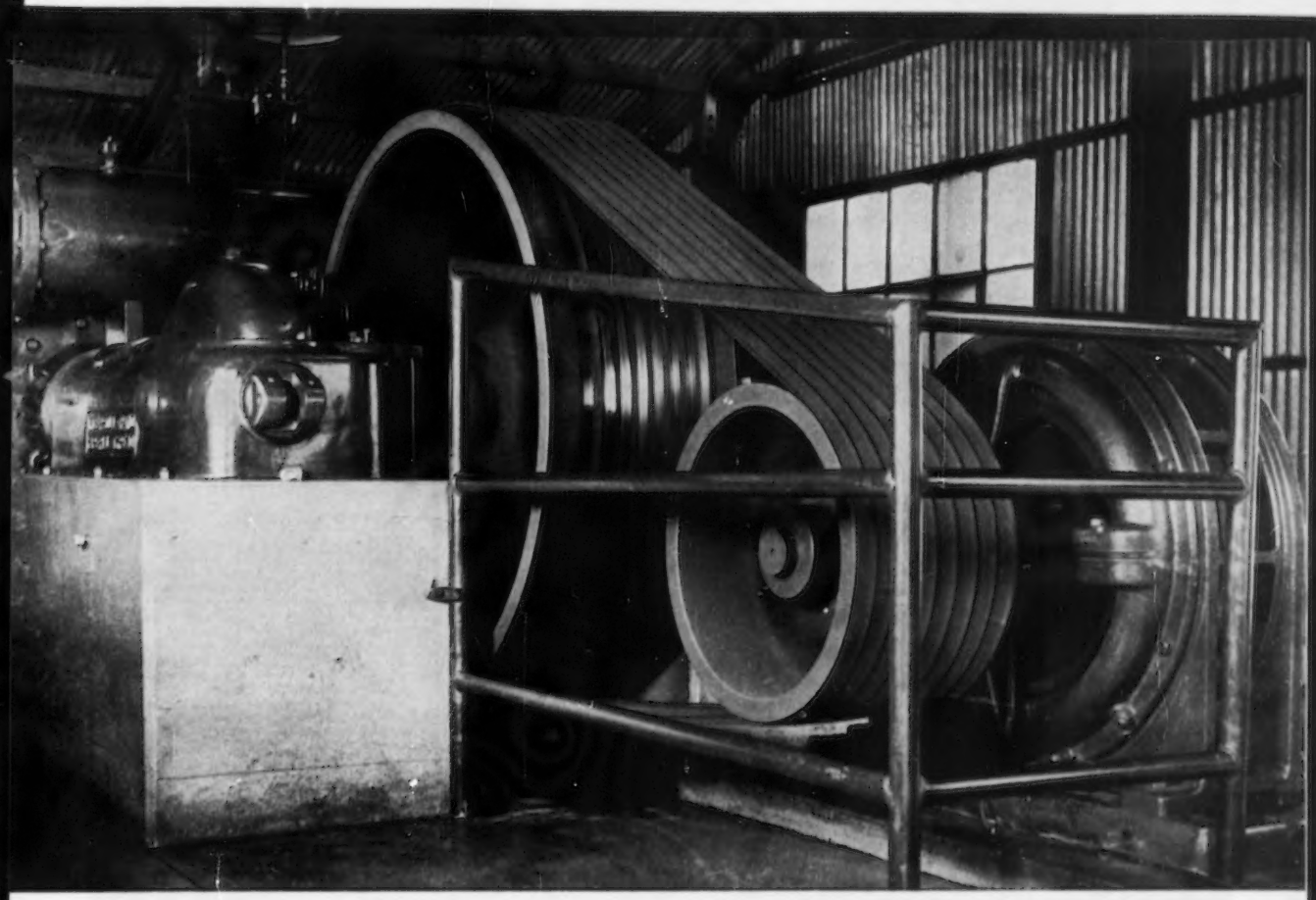
Javelin recently acquired an additional 2,400 sq mi of mining concessions adjacent to the 2,300 sq mi concession on which the Wabush deposit is located.

Chib-Kayrand Copper Mines adjoining the Campbell Chibougamau has plans for extensive geophysical work. The ground, a merger of claims held by Kayrand Mining and Development Co., Royrand Gold Fields Co., and Quebec Smelting & Refining Co., extends for 4-5 miles along the area's main shear zone.

Big Town Copper Mines is doing geophysical work on its 2,800-acre property in Courville Twp., 10 miles from Senneterre. Surface drilling done last year showed good structure and mineralization over a large area, and the surveying is designed to search for the most favorable sections.

Test runs on lithium ore are being made in the 100-ton pilot mill of Quebec Beryllium Ltd., 9 miles south of Amos. Material for the test is being taken from the company's property in LaCorne Twp., where a pegmatite dike, 18 ft wide, has been traced for several hundred feet. A quarrying operation is visualized, the ore being estimated to contain 20% spodumene.

Pilot mill is located at the company's second property, which is held as a beryllium prospect, with extensive tonnage of material carrying values in beryl, mica, and columbium-tantalum.



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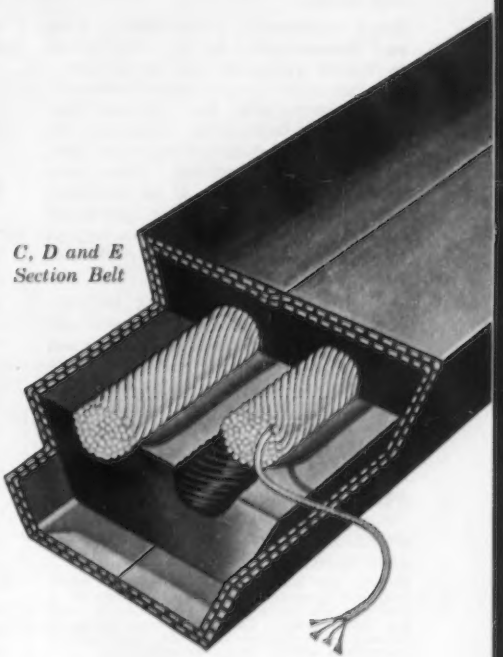

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NEW BRUNSWICK

First ore seen underground by Brunswick Mining and Smelting Corp. looks just as good as the promises that were made by surface drilling. Crosscut on the 350-ft level from the shaft at the Anacon-Leadridge orebody entered the ore ahead of schedule and the first 60 ft averaged 6% lead, 13% zinc, 0.4% copper, and 3.0 oz silver per ton, while a flat drill hole ahead of the face showed another 140 ft of similar ore. The 150-ton pilot mill at the property has been completed, and tests are being run on ore from the development headings.

Astrabrun Mines, with 246 claims located 1.5 miles northeast of American Metal Co.'s copper-zinc property in the Bathurst-Newcastle area, has started a large scale program of geophysical surveying. The project is financed and managed by Noranda Mines, Mining Corp. of Canada, and Anglo-Huronian Ltd.

Anacon Lead Mines is drilling in two New Brunswick locations. One is the former New Larder "U" Island Mines' No. 50 group, adjoining the American Metal Co. property in the Bathurst-Newcastle area. Anacon acquired it when the two companies merged last year. Second location is northeast of the original New Larder ground south of Bathurst, where a 316-claim group is being explored jointly by Anacon and St. Joseph Lead Co.

Fab Metal Mines is doing electromagnetic surveying on its ground adjoining Brunswick's Anacon-Leadridge group in the Bathurst area, to search for the southerly extension of the Brunswick's "S" zone, a structure that has been traced to within 300 ft of the Fab boundary.

MEXICO

Operators of small and medium mines have petitioned Mexico's treasury department for additional tax relief. To support and stimulate small mining operations, Mexico has granted rebates on taxes which amounted up to 200,000 pesos. This maximum of 200,000 pesos was set before the peso devaluation last April, at which time the export tax was raised from 15% to 25%. The small mine operators are asking that this maximum be extended to 350,000 pesos, to adjust for devaluation and export tax rise.

Cia. de Azufre Vera Cruz, S.A., operating subsidiary of Gulf Sulphur Corp., of Houston, has expanded its estimated reserves for further exploration and at the same time is rushing completion of its plant which is slated to begin production in June.

In 75 acres of Gulf's 7,414-acre concession at Salinas on the Isthmus of Tehuantepec, an estimated 10.9-million long tons have been proven, according to Walter H. Maddox, company geologist. In addition, Maddox said, another 2.7-million long tons are considered probable.

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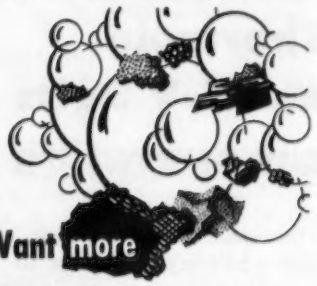

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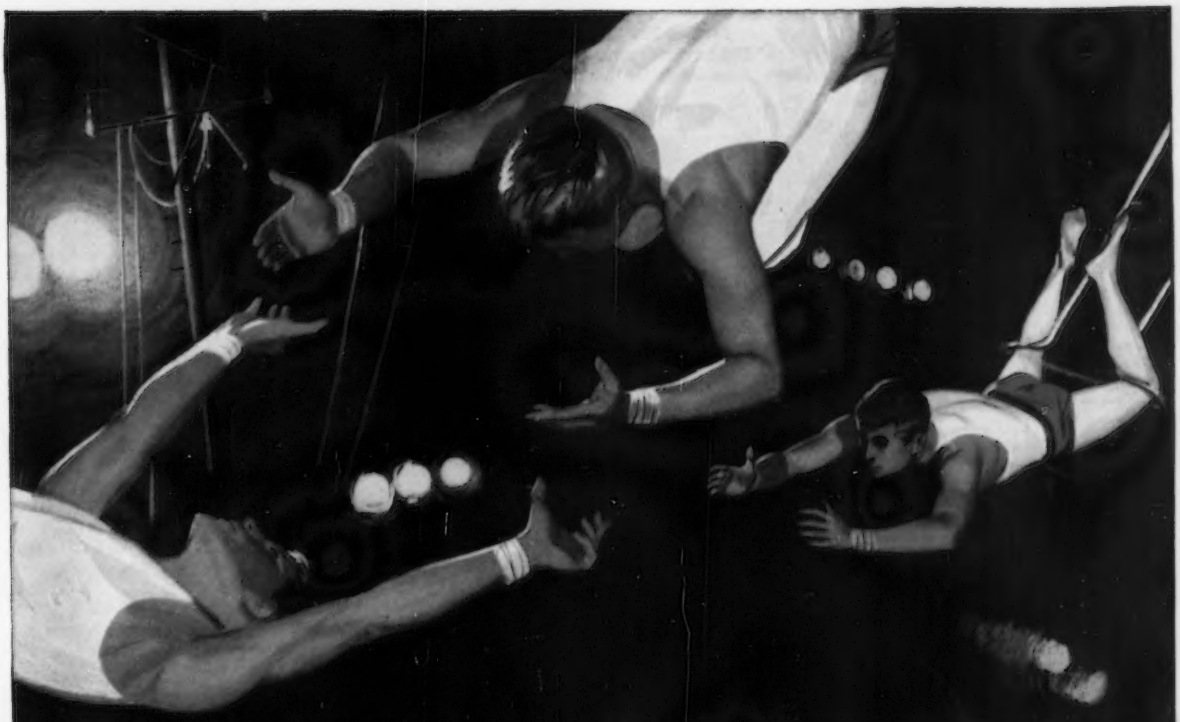

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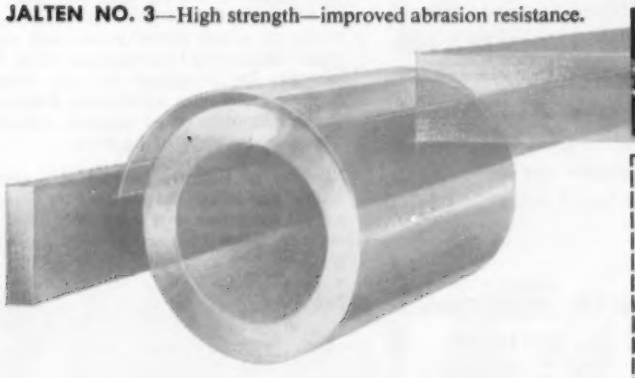

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Mexico *(Continued)*

Mexican Sulphur Co., S.A., operating subsidiary of Mexican Gulf Sulphur Co., also has increased its reserves and has added a sixth pipe flowing into its relay station.

Maddox, who serves also as chief geologist for Mexsul, reported that a new well drilled March 5 showed 15 sulphur feet in 53 ft of sulphur-bearing limestone. The geologist said that it was the richest Mexsul core yet and, what was even more important, the well was drilled in an area which had not hitherto been explored.

Mexsul has been averaging about 250-300 tpd from six wells at its San Cristobal concession. Maddox said that wells in the new area will be equipped for production immediately and that he believes that output will be substantially boosted. New wells will replace the lowest-producing wells now in operation. Also, to boost production, a new boiler has been authorized which would raise Mexsul's plant's superheated water capacity from the present 1.2-million gpd to 2-million gpd.

Pan American Sulphur Co.'s concessions, located at Jaltipan, 25 mi from Coatzacoalcos, last month reportedly was producing at the rate of 1,500 tpd.

A mud-filtering system has been intro-mud-filtering system has been introduced into wells at Jaltipan in hopes that the mud will rid the sulphur of its off-color characteristics, caused by minute amounts of carbonaceous material in the dome.

Sociedad Cooperative Santa Fe de Guanajuato, in Guanajuato City, last month began reopening the Encarnacion gold-silver mine, one of the oldest mines in the district. Production was slated to begin this month.

Cooperative, composed of 1,000 worker-owners, has been working the Veta Madre, the Guanajuato mother lode, through its Cata, Rayos and Promontorio mines. Encarnacion mine is an extension of the Veta Madre workings.

Eng. Alfredo Terrazas, general manager, reported that the old fillings assayed 3 to 10 g gold per ton and about 150 g silver per ton. The vein is quartz and the country rock is Guanajuato red conglomerate.

The cooperative owns a 10,000 tpm capacity mill. Concentrates from the mill are sent by rail to Cia. Metalurgica de Penoles' smelter at Torreon.

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IN LATIN AMERICA

ARGENTINA

Geotécnica, S.A. Comercial e Industrial, announced that it has considerably expanded its mining activities. Originally starting as mining consultants doing geophysic and geologic studies, the mining corporation is today operating with an authorized capital of 5-million pesos, and is actively engaged in exploratory and development work in several parts of the country.

Operating with its own pilot plant at Facundo Quiroga, Department of San Antonio de Oeste, Rio Negro Territory, it is currently mining lead and zinc in that area, which is now the company's major proposed future production program. According to a statement made by manager Dr. Francisco de Luca Muro, recently Geotécnica added to its activities the development of an uranium mine in Chilecito, Province of La Rioja.

Ministry of Industry has issued a resolution regulating the manner of fixing annual extraction quotas for new sulphur deposits. The same measure is also applicable to beryllium.

In accordance with these measures, new sulphur and beryllium deposits must be worked for two years, before their annual production quota can be fixed.

BOLIVIA

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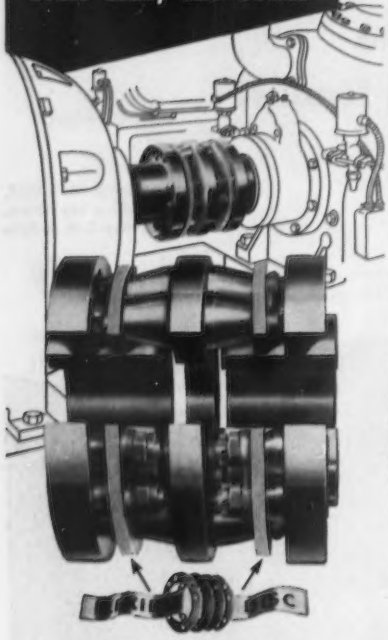

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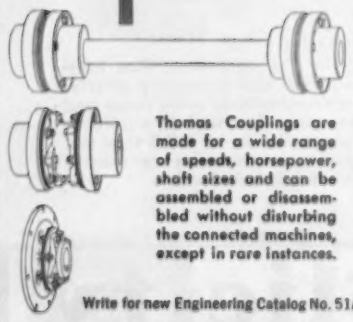

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Bolivia *(Continued)*

facturing and agricultural enterprises desirous of making capital investments in the country.

In view of the country's need of foreign capital to develop its potential riches, the Ministry of National Economy and Finance announced that the government is ready to grant such capital every facility and guarantee.

It recalled that the law of Oct. 17, 1954, drawn up by members of the present government, authorizes withdrawal as profits up to 15% in the same currency as the capital invested. The law in question refers to investments in agricultural, livestock and derivative enterprises, manufacturing industry, transport systems, and construction of hotels and low-priced houses. The Ministry added that this law must be amplified to include new legal measures in favor of foreign capital, to contemplate incorporation of guarantee and exchange rates for reexportation of capitals and profits.

CHILE

Chile's principal copper mining companies in 1954 produced 325,000 tons of copper, notwithstanding reduced work and strikes in the Chuquicamata, Potrerillos and El Teniente mines.

This was announced recently by the Under-Secretary of Mines, who added that it is estimated that this year's production will total 420,000 tons, as the companies propose to increase work.

Medium and small copper mining enterprises produced some 36,000 tons in 1954, and according to estimates of the Department of Mines and Fuels, their 1955 production will total 44,250 tons, which alone will render $26-million volume production.

On March 10th, preliminary work was started, previous to commencing production, in the "La Africana" copper mine, situated some 20 km from Santiago, by an affiliate company of Anaconda.

Ministry of Mines, announcing the news, indicated that initial production will be 12,000 tons yearly, and will be increased to a total of 25,000 tons. Blocking out of the mine established a reserve of 2-million tons of ore.

Ministry added that explorations undertaken by an U. S. engineer in the "Indio Muerto" deposits, nearby Potrerillos, have revealed important deposits of the red metal. It further stated that should the investigations continue to show good results, they would solve the problem posed by the low capacity of Potrerillos, which has a production only estimated to last five years more.

Corporación de Fomento de la Producción—CORFO—will shortly commence study of a project for the installation of copper refineries and smelter plants in the Province of O'Higgins.

Meanwhile, a bill has been submitted to CORFO, for tabling with Congress, whereby the province's political and administrative prerogatives would be extended to give it an outlet to the Pacific to facilitate transportation of future production.

Mauricio Hochschild & Co. has taken an option on the Veta del Agua copper mine, high grade copper vein located near El Soldado mine which belongs to Cie. Miniere du M'Zaita. Both Veta del Agua and El Soldado are located near Nogales, Aconcagua province.

Cia. Comercial y Minera Sali Hochschild began operating its 20 tpd sulphuric acid plant at Copiapó, Atacama province, built by Lurgi of Frankfurt. It has also started operating its new 70 tpd leaching plant. Ore is ground in water, thickened and pulp is agitated in dilute sulphuric acid and washed by counter-current decantation.

According to the Minister for Mines, the President will veto the bill passed by both Houses giving a new deal to the U. S. copper companies on the following points:

1) On giving the Banco Central (Chilean Federal Reserve Bank) duties of controlling the operations and costs of the U. S. copper companies which the Administration wants to be carried out by a new agency to be known as "Instituto del Cobre" which was the controlling organization in the original bill as drafted;

2) Some changes in the taxes imposed on the copper companies and the representation that the producers will have on some fiscal agencies, such as the Paipote smelter.

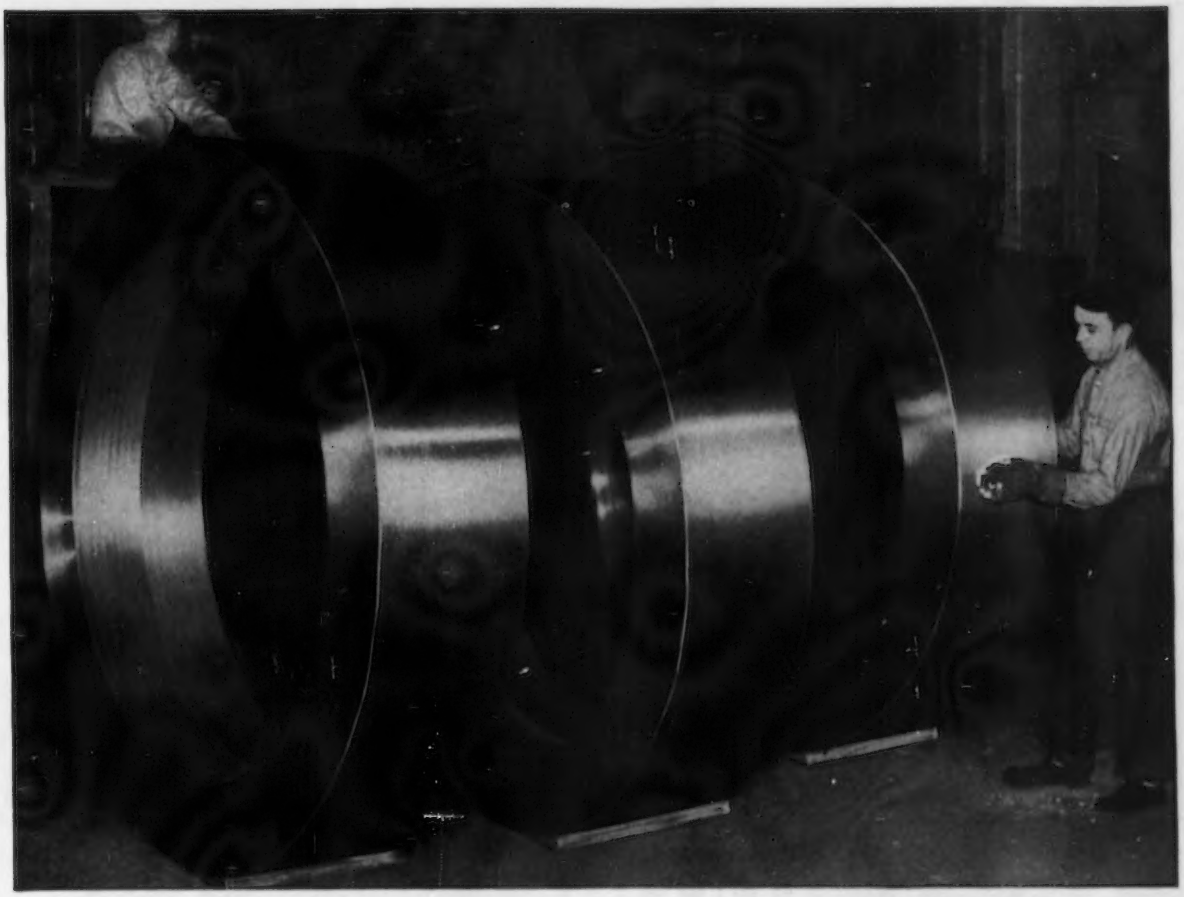
Fundición National de Paipote, the government's copper smelter near the town of Copiapó, Atacamo province, has decided to install a new Babcock and Wilcox boiler capable of taking the whole of the gases from the reverbarotory furnace. New boiler will be of the waterwall type to avoid the trouble caused by the fused dust particles at high temperature carried over by the gases when they hit the regular boiler tubes and stick, as is the case with the regular type boilers which require a lot of air-lancing by hand.

Government decree has fixed the rate of exchange with the dollar for certain important raw materials and food-stuffs at 110 pesos for this year (present free rate for the dollar is 346 pesos). Therefore, the U. S. Copper companies had to continue to exchange their dollars at the Central Bank at 110 pesos until March 31 when they obtained 200 pesos per dollar.

Cia. Minera Aysen is producing lead concentrates at the rate of 450 tons per month with 72% lead and 350 tons of zinc concentrates with 54.7% zinc.

COLOMBIA

Luis L. Suescún and Dr. Carlos Uribe have installed a furnace and eltctrolytic refining plant for lead near Guicán on the slopes of the snow peak of the Cocuy in northwestern Colombia. Extensive galena deposits with a lead content of over 80% have been discovered there by



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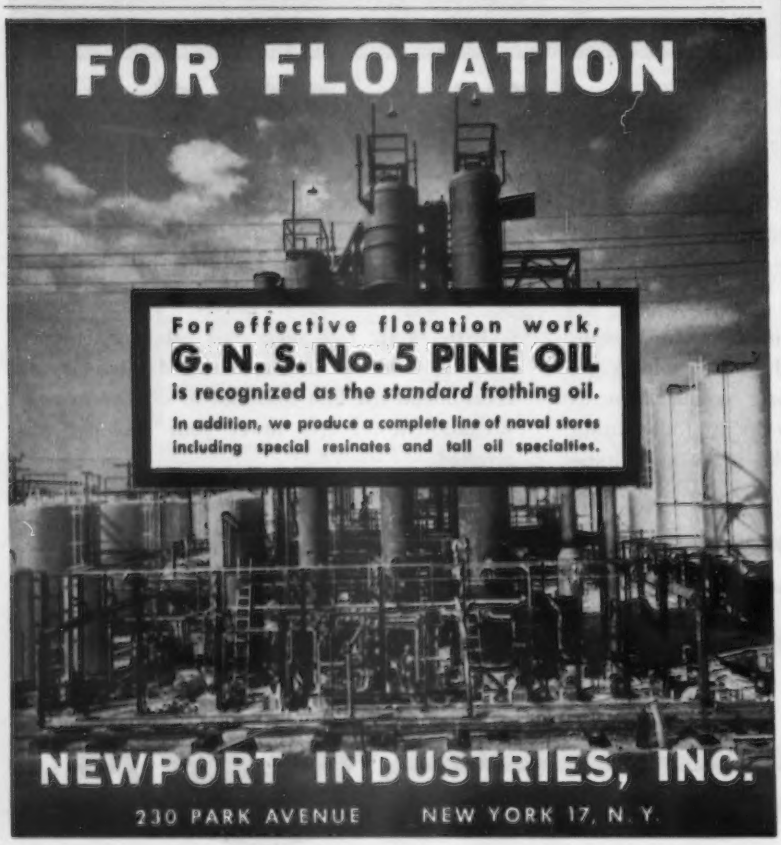

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is recognized as the *standard* frothing oil.
In addition, we produce a complete line of naval stores including special resinates and tall oil specialties.

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Colombia *(Continued)*

Dr. Uribe, a mining engineer. 2,000 metric tons have already been extracted from the mines and are ready for processing in the Swedish furnaces now being installed.

Refining equipment is of German origin while the 75-kw hydroelectric power plant was purchased in the U. S. Up to now the two partners have invested 130,000 pesos in developing these deposits. They expect to be able to sell the first metallic lead in May. The output is estimated in 10 to 12 metric tons per 12 hours.

Mineral contains small amounts of gold and silver which can be recovered as soon as enough slack has been accumulated and will then help to make the production cheaper. Analysis of the mineral made in the U. S. gives the following contents: 80.5% lead, 2.6% iron oxyde, 2.5% antimony, small traces of bismuth, 1.94% zinc and 95 g silver and 5 g gold per ton.

U. S. firm, Mining Enterprises Corp. of Denver, Colo., is going to reopen the gold mines of Marmato in the Caldas Department. In size these mines can be compared with those of Cripple Creek, but mineral has a higher gold content and never falls below US $10.80 to $12.00 per ton.

Works on these gold deposits began Feb. 14. 300 tons will be treated per day with 250 workers, most of them locally hired, among them 14 Colombian engineers and six U. S. experts.

JAMAICA

Jamaican production of alumina may be expanded to as much as 450,000 tons annually, compared with the present annual rate of 230,000 tons, said N. V. Davis, president of Aluminium Ltd., Montreal, when he announced plans for new capital expenditures totaling £4-million.

Money will be used to increase supplies of Jamaican alumina for the Kitimat smelter in Canada. In the first instance, it was expected to raise the Jamaican output by 70,000 tons a year to 300,000.

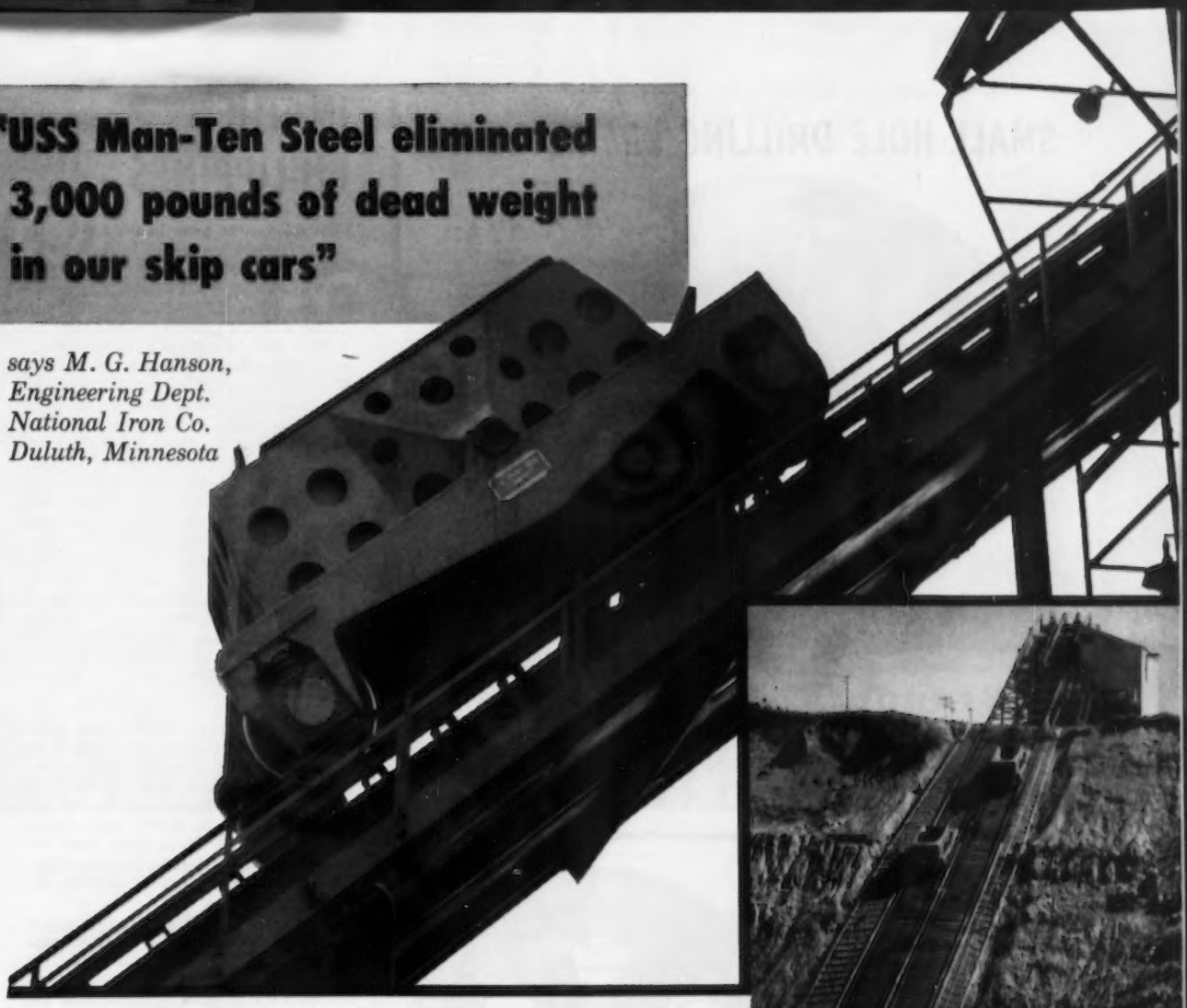
PERU

Cerro de Pasco Corp. announced that based on preliminary production results for 1954 more than half of the minerals and chemicals produced exceeded 1953's productions, some being all-time records. Figures for 1954 were:

		% of 1953
Refined copper	55.8 million lb	108
Refined lead	127.3 million lb	98
Electrolytic zinc	26.4 million lb	134
Electrothermic zinc	7.6 million lb	...
Sulphuric acid	30.1 million lb	104
Calcium arsenate	2.2 million lb	75
Copper sulphate	2.4 million lb	63
Bismuth	691.6 thousand lb	109
Zinc sulphate	748.6 thousand lb	40
Antimony	503.8 thousand lb	105
Cadmium	27.7 thousand lb	170
Silver	10.1 million oz	106
Gold	43.4 thousand oz	97

"USS Man-Ten Steel eliminated 3,000 pounds of dead weight in our skip cars"

says M. G. Hanson,
Engineering Dept.
National Iron Co.
Duluth, Minnesota



Rockover Skip Cars have to be tough, durable and as light as possible. They run up and down steep inclines almost continually. And because they're dump-type cars they have to resist abrasion.

"Cut down the weight of skip cars," says Mr. Hanson, "and they move faster, carry bigger payloads and require smaller, less expensive hoisting equipment. We accomplished all these things by using USS MAN-TEN Steel in our skips. Because this steel is extra strong we are able to use it in thinner sections to reduce weight, and at the same time maintain the high strength required of our heavy duty cars.

"Here are three reasons why we used USS MAN-TEN in our skip cars: it's easy to work, it's easy to weld, and it resists corrosion."

An accident proved why Man-Ten is best.

One day when a loaded car was halfway up the incline the power failed. Because the brake arrangement had not been set for automatic emergency operation the loaded car crashed to the bottom, and the empty car, used to help counterbalance the load, sailed over the top of the incline and landed 300 feet away. What happened? The loaded car suffered only a bent frame and was returned to service immediately. The empty skip was bent and distorted, but there was no breakage. After being straightened in the repair shop it too was returned to service.

United States Steel produces three different grades of USS High Strength Steel—COR-TEN, MAN-TEN and TRI-TEN—each having distinctive characteristics and each recommended for certain end uses where its specific properties will assure longer service and greater over-all economy. All three grades have a yield point 50% higher than carbon steel and all offer properties which allow greater strength and toughness to be built into the vital parts of machinery, equipment and structures most prone to failure.

In the mining industry these steels can be used to replace carbon steel in the vital parts of mine cars, dozers, shovels, draglines and other such equipment to increase service life without increasing dead weight. And if the use of thinner sections is possible, they can (1) reduce equipment weight without reducing its strength, or (2) increase the size and capacity of equipment without increasing the total weight or the power needed to move it.

For more information, write or call our nearest office.

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NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
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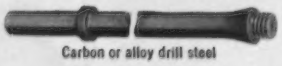
Carbide Rok-Bits—chisel or cross types —1⅛- thru 4-in.



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Mines of almost every type have benefited by the use of this proven 3-point approach to lower drilling costs—(1) airlegs (2) small hole drilling (3) NON-RIFLING Rok-Bits.® Operators report doubling their drilling speed, lowering first-cost on drill steel, saving on explosives and a real saving in compressed air. Non-Rifling Rok-Bits available 1¼-in. gauge up; carbide inserted Intra-Set Drill Steel, 1⅛-in. up. Learn what this technique can do for you. Write plant nearest you.

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IN THE PHILIPPINES

First quicksilver mine in the Philippines should get into production by June under management of Marsman & Co., who have a contract to act as managing agents for five years. Firm has recently purchased a Gould rotary type furnace.

Plant will be erected by a new Marsman subsidiary, Palawan Quicksilver Mines, Inc., organized by Filipino and American capital to develop the deposits, located in Puerta Princessa on the island of Palawan. It is expected that the plant will handle about 2,500 tons of ore per month, with an estimated production of 200-250 flasks of quicksilver. Exploration has indicated that cinnabar is distributed over tracts aggregating about 15 hectares in area. Ground has been tested with pits 1-8 m deep at 20-m intervals. The ore appears distributed irregularly in siliceous material with various concentrations ranging from 2 lb to 20 lb quicksilver per ton. Preliminary calculations of reserves approximate 75,000 tons to shallow depth.

Radiometric surveys on the Larap property of the Philippine Iron Mines in Camarines Norte gives evidence of uranium occurrence over a much wider area than was first indicated. While the deposits appear to be spotty, some assays as high as 1.5% U_3O_8 have been obtained. Along with the uranium, appreciable amounts of copper, molybdenum and gold occur as well.

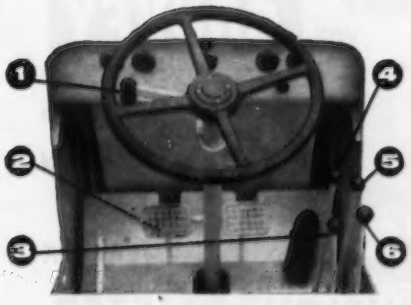
Exploration work thus far indicates a substantial orebody. The company has increased its capital to develop the new orebodies. Part of the funds will be used as well to supplement the loan which three Japanese steel mills have agreed to make on a long term basis for the construction of a beneficiation plant.

This will make it possible to utilize a lower grade of iron ore which at present is going to waste. Under the agreement the Japanese steel mills have contracted to buy iron ore for five years at an annual rate of 1,200,000 tons. The new plant is scheduled for completion in about a year's time. Development work at the Larap mine has increased reserves to a total of 24,500,000 tons at the end of 1954. Over 2,900 men are employed at the property. January production was 79,200 tons valued at 1,296,500 pesos.

First shipments of copper concentrates from the new 4,000-ton mill of the Toledo Copper mine were scheduled to leave for Japan by the end of March. Barring any unforeseen setbacks it is expected the mill will be in full production by May. Within the next few months it is planned to build a sulphuric acid plant to utilize the by-product pyrites obtained in milling. Overall cost of the complete plant will exceed $5-million.

If freighters are available it is expected that Consolidated Mines will ship an average of 40,000 tons of chromite ore

Faster, more power,
and LOOK, NO CLUTCH!



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2. **That's no clutch!** It's a double-pedal brake, use it with either foot.
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Until you see a MICHIGAN in action, you won't believe that it's possible to deliver so much power with such ease of operation. Your driver stays at peak efficiency all day long because there's no conventional clutch on a MICHIGAN. Instead, the MICHIGAN's exclusive power-shift transmission does all the shifting hydraulically—and eliminates the most notorious cause of excessive maintenance and driver fatigue.

In addition to effortless, instantaneous shifting, you get up to 300% torque multiplication on a MICHIGAN —from the Clark-built converter. With this kind of smooth, shockless power transmission, you get the full advantage of the MICHIGAN's extra weight and higher horsepower.

A demonstration (on your own job, if you wish) is the only way to get a real understanding of what this machine can do! Just write or call us—and don't forget that all MICHIGAN's are available on the low-cost MICHIGAN Lease Plan.

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Philippines *(Continued)*

per month during the first half of 1955. Completion of the railroad from the loading pier to the mines will result in lower hauling costs.

Main shaft of Surigao Consolidated has been extended from the 700 to the 900 level and an exploratory winze is being sunk from 900 to the 1100.

Hixbar Mining Co. controlling the copper deposit on Rapu island has terminated its contract with Nielson & Co. Floyd O. Merrill formerly with Balatoc Mining Co. was made general superintendent of Hixbar.

Paracale Gumaus Consolidated Mining Co. has resumed work at its property in Paracale with a 50-ton mill, after lying idle since the beginning of the war.

Gold production in the Philippines in 1954 amounted to 416,048 oz, off 64,577 oz or 14% from 1953. Largest producer was Benguet Consolidated, with output of 107,759 oz. Lepanto Consolidated, primarily a copper mine, recovered 68,013 oz of by-product gold during the year, which made it the third largest gold producer in the Philippines.

New 1,250,000-peso plant belonging to the Reynolds Metals Company is scheduled to start operation near here on June 1.

Factory will have an annual capacity of 25,000,000 lb of various aluminum products—plain and corrugated sheets for the construction trade, circles and blanks for the manufacture of kitchen utensils, foil for the cigarette, candy and other industries.

IN AUSTRALIA

Chances of foreign participation in some of the largest uranium projects in Australia have decreased as a result of the unsuccessful Rio Tinto attempt to enter the field. Rio Tinto contacted several of the larger Australian companies with undeveloped resources and three of the largest have refused the offer of partnership. Further negotiations are under way but only North Australian Uranium Corp. is favoring the idea because it may mean the establishment of a treatment plant on the South Alligator uranium field.

A number of U. S. companies reportedly had undertaken initial surveys of Australian uranium projects with a view to partnership with Australian companies. No decisions are likely before April or May 1955 at the earliest.

Total mine production of gold in Australia for the months January to November 1954 was 1,019,040 fine oz. This is 49,899 fine oz or 5.1% more than in the same period in 1953 but is still 473,223 fine oz or 31.7% less than in the same period of 1939. Latest figures are for November 1954, when mine output of gold exceeded previous month's figures by 7.6%. Exports of gold are now concentrating almost exclusively on Hong Kong as the relatively best market.

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shuttle car cable
lasts 4 times as long*

Take the average life of the shuttle car cable you're now using. Multiply it by four. And you get the *minimum expected life* of the new Hazacord Red Saddle Hex-Tite Twin for shuttle car service.

The reasons for this greatly increased life expectancy? Look at the red portion of the illustration—that's a *preformed* protective wall of red neoprene which assures a uniformly thick fill between conductors . . . gives added security against short circuiting due to run-overs by heavy equipment . . . locks Hex-Tite conductors in place to prevent internal slippage.

Now available to the mining industry for the first time, Red Saddle has all the other features that have made Hazacords first choice for rugged shuttle car service:

1. Hex-Tite non-slipping construction for longer life.
2. Compensated stranding to prevent opening-up of conductor strands when flexed.
3. Strong, resilient, heat-resisting insulation.
4. Tough, flame-proof, moisture and abrasion-resistant sheath.
5. Shaped conductors locked in place by solid sheath.
6. Extra flexibility for high-speed reeling.

* Actual tests on the special testing machine developed by Hazard engineers to simulate the pulling, twisting and bending of the severest mining machine service showed the new Red Saddle Type G Twin withstood more than four times the test cycles of old style Twin Type G.

And Type G Red Saddle Twins have a special *round* ground instead of the old-fashioned flat type. This exclusive design provides maximum protection between ground wire and power conductors, adds flexibility to the cable, markedly reduces ground wire breakage and consequent cable failures.

For full details on the new Hazacord Red Saddle Hex-Tite Twin, see your Hazard representative or write to Hazard Insulated Wire Works, Division of The Okonite Company, Passaic, N. J.

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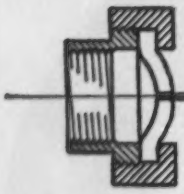

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Australia *(Continued)*

Huge new copper orebody was discovered by Peko Gold Mines N.L. of Tennant Creek. Peko's first inclined drill hole to explore the lode at depth has revealed a lode 63 ft wide whose average vertical intersection is at 730 ft. Copper values ranged from 3.6% copper in the intermediate zone to 6.4% for the last 11 ft. Gold assays are not yet known. The hole has been completed at an inclined depth of 963 ft and further drilling is expected. Vertical winze from the 400-ft level entered ore at 445 ft and from there to 500 ft the assay was 10.9% copper.

Possible new orebody find was reported from Tasmania by Montana Silver Lead N.L. A geophysical survey by the Bureau of Mineral Resources indicates an orebody in virgin country two miles from the company's mill. Further prospecting is planned.

Wah Chang Corp. of New York, N. Y., has established an Australian subsidiary. Wah Chang (Australia) Pty. Ltd. will buy ores from and act as agents for producers of rutile, zircon, tantalum, antimony and tungsten. At least two other U. S. ore buyers are considering a similar step.

Northwest Tantalum N.L. has commenced the recovery of tantalum concentrates with a 65% result. Shipments will be made to the United States.

A major discovery of rare earths was made on the Mary Kathleen uranium fields owned by Australasian Oil Exploration Ltd. In addition to uranium oxide, assays showed over 20% of cerium-lanthanum rare earths and about 6.0% of other rare earths. The economical value of the discovery is being closely investigated.

Central Mines N.L. reports good yields of gold at its Burnt Shirt lease. In the last eight weeks 620 tons of ore have yielded 1102 oz in addition to an estimated further 350 oz in tailings. No. 1 development shaft is down to 50 ft with the crosscut proceeding. The underhand stope is showing face values of 45 dwt over a width of 16 ft.

Promising new finds of iron ore are reported from South Australia. Three miles north of Iron Knob a drill has penetrated to a depth of 150 ft in high-grade ore. BHP is now paying increased royalties for iron ore from South Australia and the South Australian Mines Dept. is speeding up its search for new iron ore deposits. Extensive beds of low-grade iron ore will not be exploited in the hope that high-grade ore will be discovered in adequate quantities.

Uranium Consolidated N.L. has extended its operations into the base metal field. An option has been acquired over the Ortona copper mine and some other copper leases. Company has also entered the rutile sand field and has a controlling interest in a promising rutile field near Lennox Head, N. S. W.

West Australia's gold production for

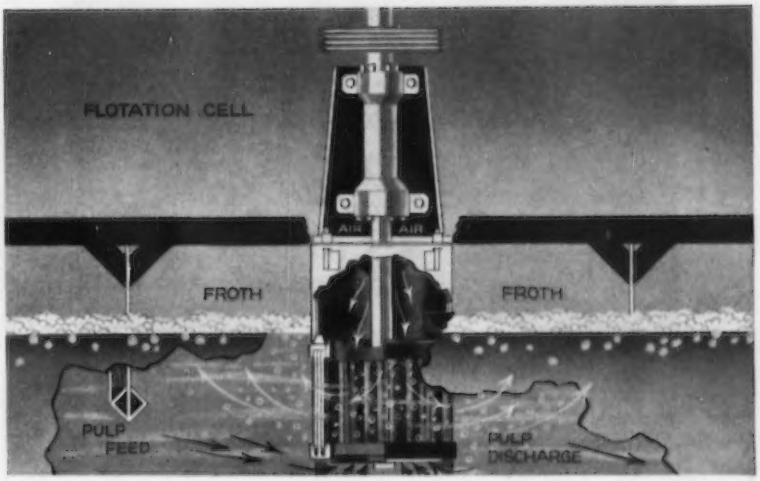
NOW... Cut Froth Flotation Expenses With GUARTEC

New Colloid Helps Save on Costly Collecting Agents

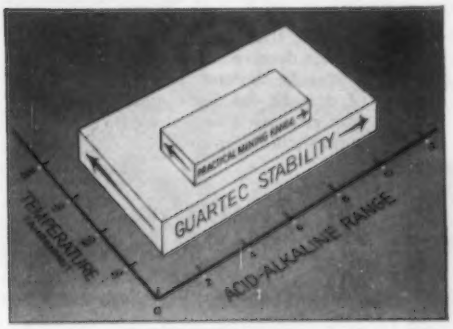
Would you like to trim froth flotation expense? You can, with Guartec—the new General Mills guar gum colloid now available in commercial quantities.

As a blinding agent for froth flotation, Guartec blocks off gangue particles so they can't pick up and adsorb expensive collecting agents. In other words, Guartec enables the collecting agent to concentrate on the material to be floated off.

Usually, just a trace of Guartec is ample for the job. As little as 0.15 to 0.25 pounds (4 to 8 cents) per ton of ore blinds the gangue matter—enabling fast, efficient ore separation with far less collector. Guartec, because of its quick dispersion maintains an effective concentration in the flotation cells at a rapid rate of pulp flow.



You Save Money on expensive collectors when you add Guartec for froth flotation. It gives you 16 to 40% cost savings compared to starches, which have been used for this operation. Operators get fast separation of potash, phosphate, zinc, iron ore—yet add far less reagent.



Guartec Works Well at any practical temperature or acid-alkaline range. It has proved stable for filtering, settling and clarifying in a pH range of 1.2 to 11 and at temperatures of 40 to 180° F.

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Guartec also is an excellent flocculant for settling or filtering operations . . . or for clarifying waters and brines.

Guartec has proved its effectiveness in thickeners to "floc" slimes from uranium, zinc, iron ore and manganese. It has clarified brines in potash refining, conserved water for reuse in iron ore processing, and has performed well in many other flocculating jobs.

In just a short time, Guartec has proved successful in ore dressing for many mineral processors. So experiment with Guartec in *your* operations. See for yourself how it can improve your beneficiation. Send for your free Guartec sample and technical data, today.

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Australia *(Continued)*

1954 rose by 27,000 fine oz above 1953 figures. Total for 1954 was 850,540 fine oz. On the other hand Victoria's production in 1954 dropped by 8,910 fine oz to 57,535 fine oz. Chief cause of the fall was the closing down of three important gold dredges and of two remaining mines in the once-famous Bendigo field.

Asnazu Gold Dredging Ltd. expects to close the No. 1 dredge in January 1956 after its reserves have been worked out. No. 2 dredge was closed down in April 1954, but has not yet found a buyer. Its hydro-electric plant and transmission equipment were sold for $180,000.

Torrington Uranium Mines reported assays of wolfram ore at an average of 5.24 WO_3. Australian representatives of U. S. interests are negotiating for the purchase of the wolfram. The same company reported a 900-ft lode at its Atkinson lease, covering torbernite for the whole length.

Nickel Mines of Australia Ltd. were to recommence field work in March. A mineralized lode has been cut at the Tolleen gold mining lease and tests will be made for thorium on a West Australian property.

Australia's first aluminum plant has begun production of alumina at Bell Bay, Northern Tasmania. When the plant becomes fully operative it will turn out aluminum ingots at an estimated rate of 10,000 tons per year. Malayan bauxite is being used at present, with plans to process domestic ore eventually.

Plant is expected to meet current level of demand for the Commonwealth, but with growing industrial consumption, imports should keep pace.

IN EUROPE

AUSTRIA

Austria produced 16,200 tons of bauxite last year, nearly 2,000 tons less than in 1953 but about 1,000 tons more than in 1952 and over 7,000 tons more than in 1951. The major part of the 1954 output was shipped to Germany for processing.

During the current year, it is planned to export some 10,000 tons.

FRANCE

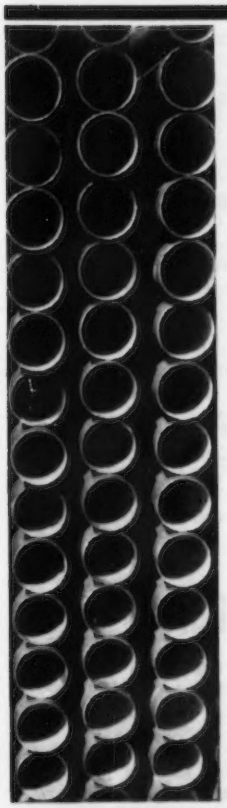
Chamber of Commerce of Limoges has decided to encourage commercial exploitation of uranium deposits found locally five years ago and believed to be the largest in France. The deposit is at La Crouzille.

Since its discovery five years ago mineralogists have found that it contains a 250-m thick seam of uranium-impregnated rock.

Chamber plans to form a company to develop the workings commercially.

ARMCO *Special Analysis Pipe*

Engineering Data and Advantages



▸ Here's a quick summary of Armco Special Analysis Steel Pipe—and its advantages in hydraulic mining, dredging, and wherever else you need dependable pipe for hydraulic material handling.

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SPAIN

New cassiterite deposit discovered at Campillo de la Jara is now being excavated and explored so that its precise extent can be determined. It is already known that the tin content is around 700 g per kilo of cassiterite, according to the Spanish news agency Cifra.

Plans are being considered by the Minas de Almaden for installation "in the fairly near future" of a second distillation unit similar to that bought from the Pacific Foundry Company, San Francisco, in January 1952, according to a spokesman of the mines. Existing unit, which has a distillation capacity of 200 tons of ore daily and comprises two furnaces, has been in operation since mid-1953, and severe difficulties were encountered in initial months of operation.

Installation of a second unit would give a theoretical total distillation capacity of 400 tpd, or 120,000 tons of ore annually assuming a year of 300 working days. Assuming a metal content of 6% and treatment losses of 5%, this would mean a metal output capacity of 6,840 metric tons a year, or nearly 200,000 flasks. If this total could be reached, it would be about four times the 1954 output and five times the output in 1953.

FINLAND

Construction of Finland's first plant for the extraction of vanadium has been begun by the Otanmäki Corporation at the site of its mine in Northern Finland.

Expected to go into production in the spring of 1956, the plant will cost an estimated $2,200,000, including all installations and housing for about 60 families. It will have an annual capacity of about 70,000 tons of ore concentrates.

Vanadium will be extracted from magnetite concentrates through a process developed by Matti Merenmies, company metallurgist, and Prof. Kauko Järvinen, mining engineer and technical consultant to the Otanmäki Corporation.

New process differs from earlier methods for extracting vanadium principally in that it is carried out at an earlier stage, before the iron ore is sent to the smelter.

After preliminary drying, the magnetite concentrate is further treated in a magnetic separator, raising the concentration to about 69% iron and 0.6% vanadium. Ore will then be sent to the new extraction plant, where it will be milled further and where sodium sulphate will be added.

The next step in the process is pelletization and roasting of the ore to form soluble sodium vanadate, which can be leached out with water. The pellets can then be sent to the iron ore smelter while the sodium vanadate solution is processed further.

Addition of concentrated sulphuric acid to the sodium vanadate solution results in the precipitation of vanadium pentoxide, which is filtered and smelted. Resulting commercial product will contain about 90% vanadium pentoxide.

SWEDEN

New type of crusher capable handling boulders weighing up to 10 tons has been designed by Morgårdshammars Mek. Verkstad, Central Sweden, in collaboration with Swedish mining engineers. A series of five units will be delivered to the Lapland mines of the Loussavaara-Kirunavaara AB.

Crushers are to be installed underground at the company's mines at Kiruna and Malmberget. They have an intake aperture of 1800 by 1400 mm (5 ft 11 in. by 4 ft 7 in.) and a crushing gap of 4 cu m (141 cu ft). Enormous strain on the eccentric bearings has necessitated the use of the largest SKF bearings ever mounted in a jaw crusher. Total weight of the crusher is 116 tons.

TURKEY

An estimated 9,000 tons of blister copper were produced at the Murgul plant during 1954. With the completion of the expansion of installations 2,000 tons of ore will be processed daily, so that 1955 production should show a considerable increase.

At the present time export orders can be dealt with only with considerable delay, production for many months ahead is already booked. The materials for the completion of the second stage of the construction of the sulphuric acid plant at Murgul have arrived in Turkey and those for the third stage are expected shortly. Plant is due to be completed by the end of 1955.

IN AFRICA

Closing of the new Freddies South mine, Orange Free State, failed to surprise London mining circles. Heavy monthly losses at the mine—recently amalgamated with the separate Freddies North—have been incurred since start of production in July 1953, reports said.

Losses were reportedly due to unfavorable physical conditions underground, to the low grade of ore stoped (largely due to shale dilution), and persistently poor development results. Expectations of enrichment through surface sorting were not realized.

Such a record of early failure is unique in Rand mining. Some 800,000 tons have been milled at the Freddies South reduction works, which were in operation long before mine production began, and yielded 3.0 dwt per ton milled. The seven producing OFS mines are declaring a monthly profit of $1,300,000 and a regular increase during the year is assured.

Working losses were estimated at nearly $2-million, excluding heavy expenditures for development.

The mine is said to contain more uranium than some of its neighbors, but reported grade is low. Ore reserves at the South Freddies now being mined out, probably representing less than one year's mill supply.

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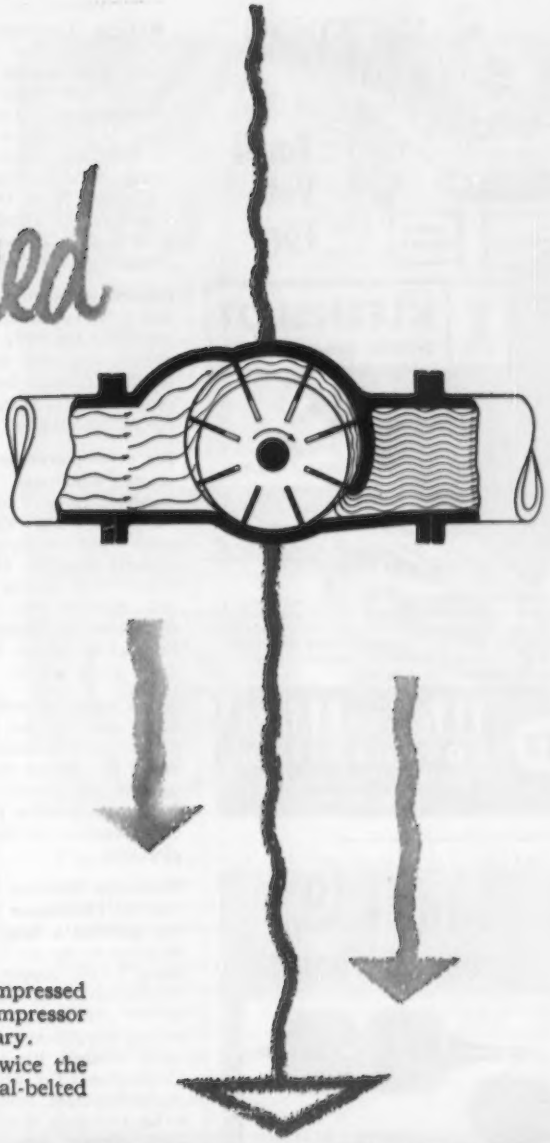

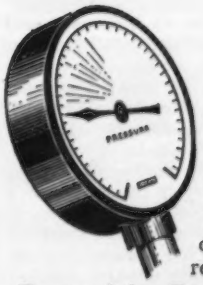

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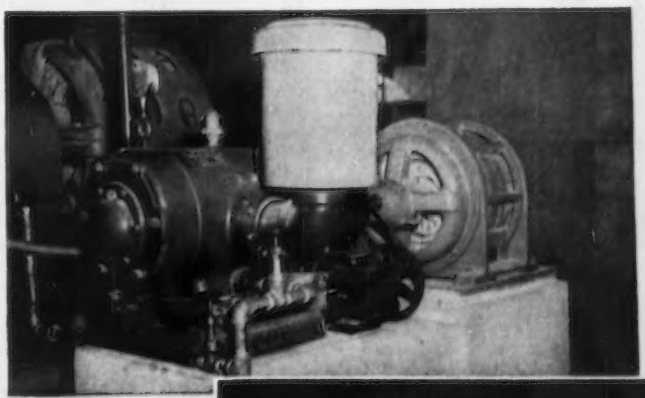

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Africa *(Continued)*

Deep level mining is being planned at the Can and Motor property in Southern Rhodesia. It is estimated that the mine must increase in depth by 200 ft a year to maintain its reserve position. Plans being made to mine to ultimate depth of 10,000 ft or 4400 ft below present lowest level. Grade of ore milled last year was 7.22 dwt gold per ton compared with 6.38 dwt for previous year.

Exports of uranium oxide and other radioactive materials (chiefly monazite concentrates) for 1954 totaled $41.5-million against just over $10-million for 1953. Profits accruing from this to uranium producing gold mines were $22.75-million against $5.5-million.

Big developments are taking place to increase Rhodesian copper production. Bancroft mine, controlled by Anglo American Corp., which is to come into production in January 1957 with an original target of 42,800 tons of copper a year is to double this by 1960. This will make it one of the largest producers on the Copperbelt. Ore reserves exposed so far are 80-million tons averaging 3.6% copper.

Anglo American, with Rhodesia Katanga, is to open up the Kansanshi property. This deposit is erratic but the engineers are of the opinion that sufficient ore is in sight to provide the mill with 3.5% ore and make sufficient profits to cover capital expenditure as well as to finance exploration.

Rhodesian Selection Trust is going ahead with its Chibuluma property, where the ore contains a large amount of cobalt. Reserves so far are 7.3-million tons averaging 5.23% copper and 0.25% cobalt. Production is expected towards the end of this year instead of 1956 as first expected. Copper deposits are being opened up in Southern Rhodesia by the Messina Development Co. which operates a mine in the Northern Transvaal. Ore reserves so far are about 16-million tons averaging 1.6% copper. Selection Trust are also reported to be investigating ground in Southern Rhodesia.

Following are main statistics of gold mining operations in South Africa for 1954 with comparable figures for 1953 in parenthesis:

Tons milled, 62,354,500 (58,772,000); yield, 12,682,328 oz (11,440,830); yield 4.068 dwt per ton (3.893); working revenue, $441-million ($397.5-million); $7 a ton ($6.75); working expenditure $335-million ($300-million). Cost per ton milled, $5.25 ($4.90); cost per oz, $25.35 ($25.15); working profit, $10-million ($9.75-million); dividends paid, $54-million ($52-million). Working revenue does not include uranium profits or those from sales of sulphuric acid.

New world record for sinking a manually-cleaned shaft was set at Vaal Reefs gold mine in the Klerskdorp district when 590 ft were accomplished to a depth of 1341 ft in one month, plus 41 ft of development in a temporary pump chamber. The shaft is circular, 18 ft diameter, and was fully concreted under full cementation cover. During the last seven days of the month 164 ft were sunk. The pump chamber was cut and walled in 24 hours. At one stage 30 ft of concrete lining was placed in 4 hours 5 minutes.

What is probably another record was also set at this mine in the sinking of a sub-vertical shaft 338 ft in a month. It is being sunk from a crosscut from the 4000-ft level and 7700 ft away from the nearest shaft. Previous subvertical record was set up at the Durban Roodepoort Deep Mine some time ago with a figure of 280 ft. The greatest depth accomplished in shaft-sinking is still held by the Merriespruit Gold Mine in the Orange Free State with 597 with mechanical cleaning.

Collapse of the strike of mine workers in Northern Rhodesia, announced March 2, means that African labor has gained virtually nothing. Mineworkers Union has exhausted its resources during the two-months' work stoppage and lost "face" as well. In some quarters it is said that African advancement schemes received a serious setback.

Branches of the European mineworkers union, which previously backed, in principle, the African union's demands for advancement of native workers, are now demanding fresh ballotting for reconsideration of the plan. A large number of white miners have changed their views, maintaining that the African workers have demonstrated they are unfit to shoulder responsibility.

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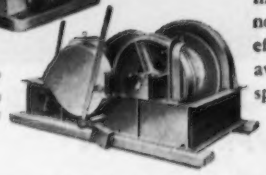

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Africa *(Continued)*

Plans approved by Central African Federation government for $240-million Kariba Gorge hydroelectric project await examination by World Bank before South Africa's Copperbelt mines can plan on power from the project.

To tide the mines over the longer period, power will come from the thermal station at Umtali in Southern Rhodesia. Kariba dam will be the biggest in the world—30 miles wide in places—and will extend upriver toward Victoria Falls gorge for 150 miles. It will hold 100-million acre feet of water. First power should be available in 1961.

Kilembe Mines in Uganda has signed a contract with Elektrokemisk A.S. for an electric smelting furnace at Jinja. Smelter is part of a five-point project which will cost an estimated $8-million. Brown Root, Houston, Tex., are consulting engineers for the smelter project.

IN ASIA

JAPAN

Japanese government and the Japan Mining Industry Association are studying plans calling for cooperation with Alaskan mining interests for the development of copper mines in Alaska.

Alaskan mining authorities are reported to have requested the Foreign Ministry to recommend Japanese industrialists willing to lend their aid to such a project.

MALAYA

Uranium has been found in the jungle of Central Malaya 10 miles from the holiday resort of Frasers Hill. Malayan scientists will search three mines in the area later in the month.

A geological official said small quantities of uranium had been known before the war to exist in the area but this find might indicate larger and possibly workable quantities.

THAILAND

Thai and U. S. governments have announced an agreement under which America will help conduct a systematic study of Thailand's mineral resources.

Mining has long been an important industry in certain parts of Thailand, with tin and tungsten being prominent exports. But little is known about the extent of mineral deposits in the country as a whole.

Under the new agreement, U. S. will spend $57,500 of Foreign Operations Administration funds on the project this year, with Thailand contributing slightly more in local currency. Agreement also covers a survey of ground water resources.

Personals *(Continued from p 114)*

annual meeting held in Reno, Jan. 15. Officers elected were: **A. E. Millar,** Anaconda Copper Co., president; **Norman E. Hanson,** Basic Refractories, vice president; and **Louis D. Gordon,** re-elected secretary-treasurer.

Alex M. McDonald

APPRECIATION

With deep sorrow we record the death of Alex M. McDonald, Oct. 27, 1954 after a brief illness in Salt Lake City.

Alex was born Aug. 24, 1901 in Butte, Mont. His boyhood years were spent in Butte and in construction camps in western Montana and British Columbia, where his father was engaged as an independent contractor during the building of the Milwaukee and Canadian Pacific railroads across the mountains to the west coast. It was natural, then, that Alex' early contacts with mining and construction led him to the Montana School of Mines in Butte where he graduated with the class if 1922.

His first job after graduation involved mine and geological model building for Anaconda in connection with litigation over certain Butte veins. The well-earned, successful, outcome of the litigation and the experience gained in applying detailed, precise methods on scale models to problems of complex structural geology sharpened in Alex an appreciation of applied geology that became the foundation on which he built his subsequent varied and successful professional career.

In November 1927, Alex married Florence Greenfield of Butte and to them were born a daughter, Joan, and a son, Alex C. McDonald.

During the late years of the twenties and into the economic depression of the thirties, Alex worked as a mining geologist for Anaconda and for the North Butte Mining Co. Also participating energetically in public affairs, he was in charge of WPA relief for the Butte community, and as Secretary-Treasurer of the Montana Section of the AIME (member 1921), he was leader for many years in the regional activities of the Institute.

In 1935, with gold mining in the ascendency, Anaconda undertook the reopening of the Mayflower gold mine near Whitehall, Mont., and Alex was placed in charge of the operation. The high ratio of net profit to relatively small output of medium grade ore that resulted from his

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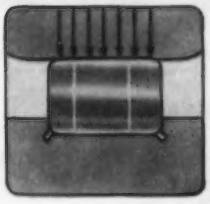

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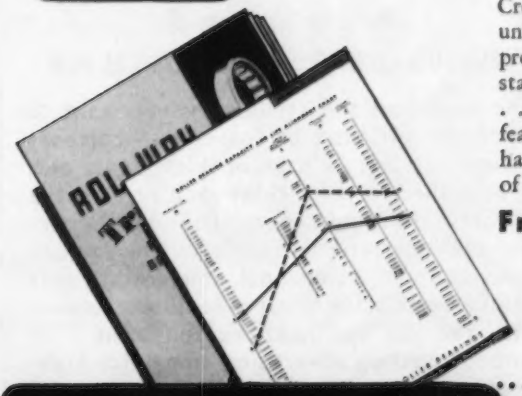

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Personals (*Continued from p 182*)

management provided a striking testimonial to the successful integration of ore finding ability and operating skill.

In 1942 Anaconda initiated exploration of the Yerington porphyry copper in western Nevada. Alex was called upon to supervise this work. When early drilling results, because of bad ground, were not conclusive, he undertook the difficult task of sinking an exploration shaft against a heavy head of water and opening the orebody with underground workings. The success of this latter phase of exploration, achieved under the most difficult operating conditions of water flow and heavy ground, led eventually to development of the Yerington mine as one of the large open pit porphyry copper producers.

Alex served as assistant chief geologist of Anaconda in charge of outside exploration in the U. S. and Canada. His many friends and business acquaintances in the two countries are living proof of his fine personal attributes.

Loyalty and honesty were his two prime qualities and these he rated over an infinite variety of technical skills in setting standards for himself. His fairness and unimpeachable honor in business and professional contacts supplied the measure of Alex character. The loyalty with which he served Anaconda in turn reflects to the honor and dignity of that company. In his death we have all lost a great and good friend who gave unsparingly of himself to do a job well and to help others.

Vincent D. Perry, Chief Geologist
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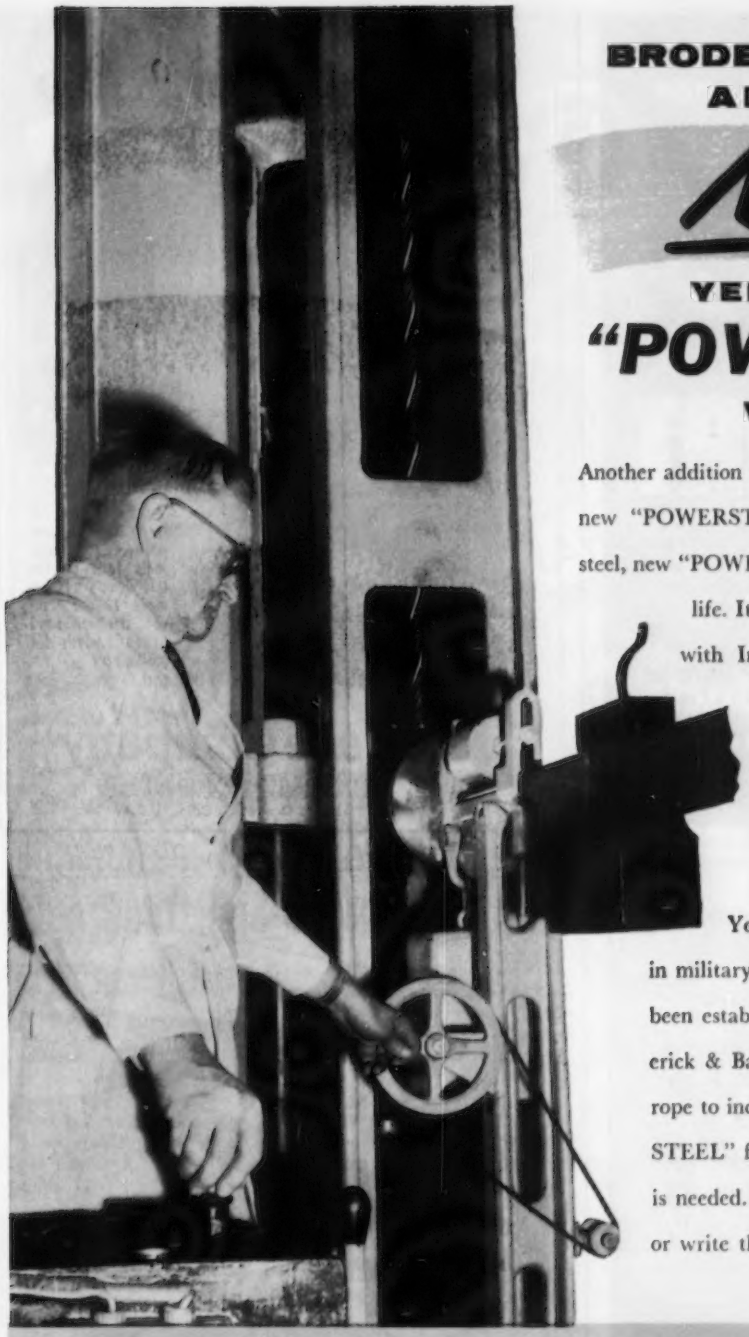

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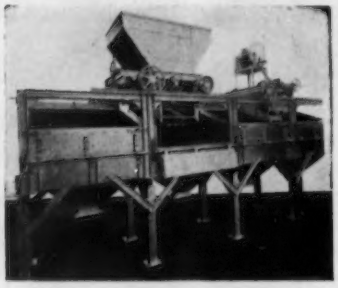

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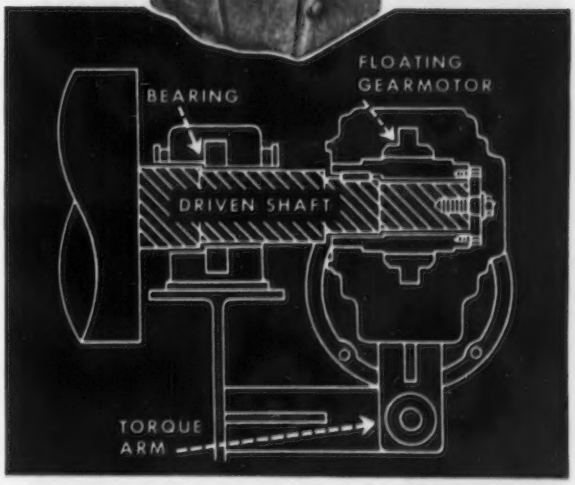

Illustration shows simplicity of assembly and mounting of the "Floating" GearMotoR in the motor-horizontal position. GearMotoR and driven shaft are supported on same set of bearings.
Note compactness of the installation.

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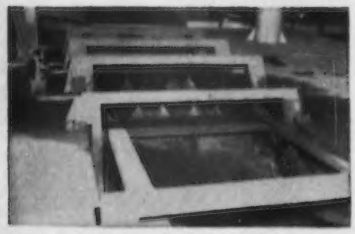

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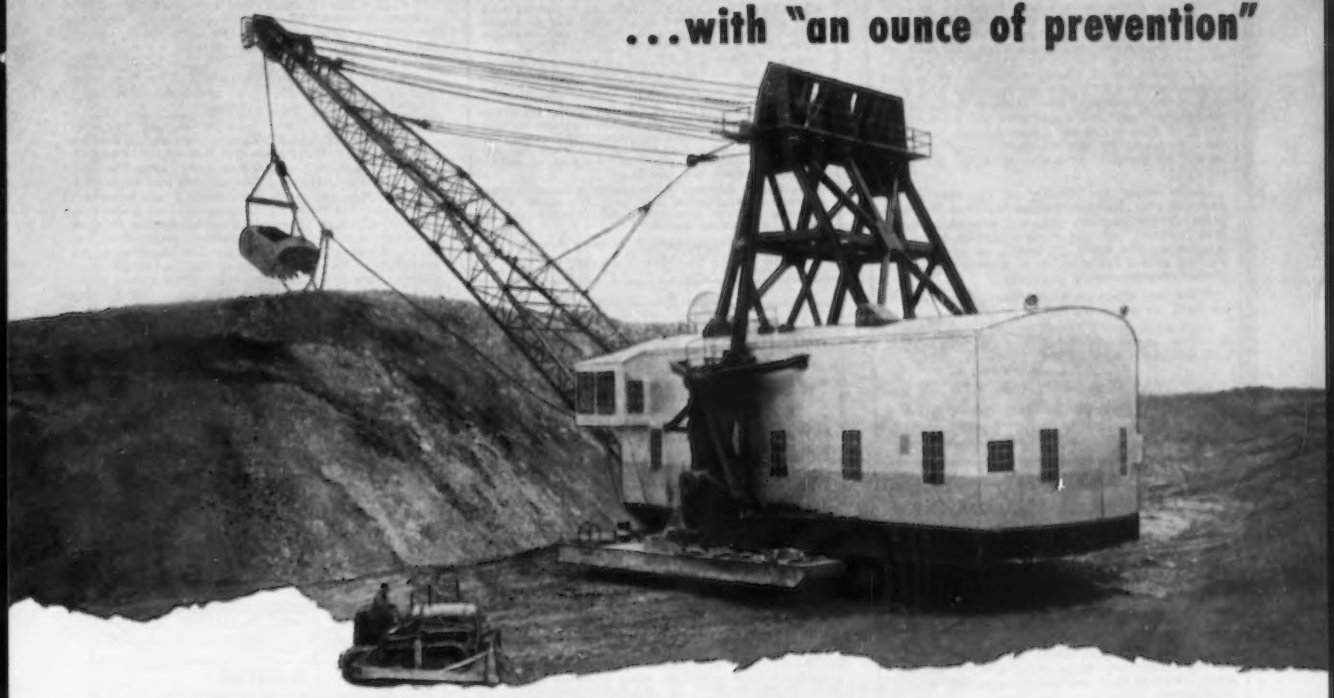

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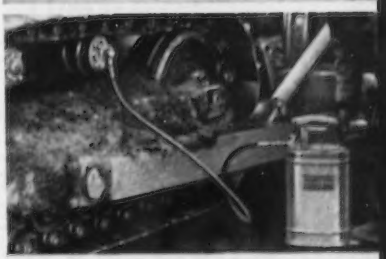

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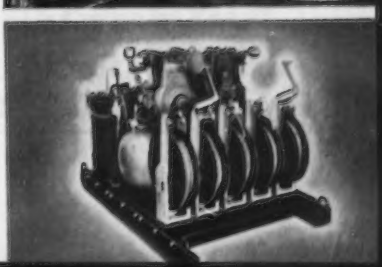

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1—2-2½ ton Whitcomb, 24" gauge
1—2½ ton Jeffrey, 36" gauge
2—3½ ton Mancha, 18"-32" gauge; with 2 sets Edison batteries
1—3½ ton Atlas, 24" gauge
1—4 ton Westinghouse, 24" gauge
1—4 ton Ironton, 36" gauge
2—6 ton General Electric
1—6 ton Mancha Trackmaster, 24" gauge, with 2 sets Gould KMZ-21 batteries
2—7 ton General Electric, 36" gauge, permissible
1—7 ton Atlas, 36"-48" gauge
2—8 ton General Electric, 36" gauge
2—8 ton Goodman, 36" gauge
3—8 ton Ironton, 24"-48" gauge
4—10 ton Atlas, 36" gauge

TROLLEY LOCOMOTIVES
1—4½ ton Goodman, 36" gauge
1—5 ton Jeffrey, 36" gauge
2—5 ton Jeffrey, 42" gauge
1—6 ton Goodman, 36" gauge
1—6 ton Goodman, 42" gauge
2—8 ton Goodman, 42" gauge
3—10 ton Jeffrey, 42" gauge
1—13 ton Goodman, 42" gauge
1—13 ton Jeffrey, 42" gauge
3—15 ton Jeffrey, 42" gauge

FILTERS
1—3' x 3' Oliver drum filter
2—4' x 8' Eimco drum filter
1—6' x 2' disc Oliver leaf filter
1—6' x 3' disc American leaf filter
1—18" Morse round pattern filter press
1—36" Merrill triangular filter press
1—#12 Sweetland filter press

DIAPHRAGM PUMPS
3—2" New Morse Diaphragm Pumps
2—4" New Morse Diaphragm Pumps
1—2" Dorrco Duplex Pump
1—4" Dorrco Duplex Pump
1—4" Barnes Pump
2—4" Butchart Pumps
1—4" Dorrco Pressure Diaphragm Pump

HOISTS
1—10 HP Vulcan #0 Single Drum
1—115 HP Morse New Single Drum
1—20 HP H&B Single Drum
1—22 HP Vulcan Single Drum #1½
1—30 HP Vulcan Double Drum
1—30 HP Vulcan Single Drum
1—37 HP Single Drum
2—52 HP Vulcan #4½ Single Drum
1—50 HP Fairbanks-Morse Single Drum
1—60 HP Vulcan #23ELF Single Drum
4—100 HP Box Single Drum
1—112 HP Vulcan Single Drum
2—150 HP Vulcan Single Drum
1—375 HP Dillon-Box Single Drum
1—22 HP Vulcan #1½ Double Drum
1—60 HP Ottumwa Double Drum
1—150 HP Dewco Double Drum Hoist
1—40 HP American 3 Drum
1—60 HP Thomas 3 Drum
1—60 HP Lidgerwood
1—80 HP Clyde 3 Drum

CRUSHERS
4—2¼" x 3½" New Morse Lab Jaw Crushers
4—4" x 6" New Morse Lab Jaw Crushers
1—9" x 15" Wheeling Jaw Crusher
1—9" x 15" Farrell Jaw Crusher
1—8" x 24" Rogers Jaw Crusher
1—11" x 18" Universal Jaw Crusher
1—24" x 13" Farrell Jaw Crusher
1—10" x 16" Hercules Jaw Crusher
1—10" x 16" Universal #3M Jaw Crusher
1—26" x 18" Williams Hammermill

MUCKING MACHINES
2—Eimco model 21 loaders
4—Conway model 50A loaders
1—Conway model 60 loader
1—Gardner-Denver model 9 loader

COMPRESSORS
1—44 CFM Ingersoll-Rand
2—88 CFM Ingersoll-Rand
1—179 CFM Ingersoll-Rand
1—360 CFM Gardner-Denver, model WBH, with 75 HP motor
1—447 CFM Ingersoll-Rand
1—637 CFM Sullivan
1—698 CFM Union
1—800 CFM Ingersoll-Rand
1—840 CFM Laidlow
1—1418 CFM Ingersoll-Rand

PORTABLE COMPRESSORS
1—105 CFM Ingersoll-Rand, gas engine driven
1—105 CFM Worthington, gas engine driven
1—210 CFM Worthington, continental gas engine
1—250 CFM Gardner-Denver stationary, Buda gas engine
1—310 CFM Sullivan, Buda gas engine
1-310 CFM Gardner-Denver stationary, Buda gas engine

TUGGER HOISTS
1—D6U Ingersoll-Rand Utility Air Hoist
1—6HC Ingersoll-Rand Air Hoist
1—Sullivan Model G-112, driven by 15 HP Wisconsin gas engine

SLUSHER HOISTS
1—7½ HP Sullivan 2 Drum Slusher
1—10 HP Sullivan 3 Drum Slusher
1—Sullivan 2 Drum Model HD-10-B, driven by 30 HP Continental gas engine

BALL AND ROD MILLS
1—4' x 3' Marcy Ball Mill
1—5' x 4' Morse Ball Mill
2—6' x 48" Hardinge Conical Ball Mills
1—8' x 22" Hardinge Conical Pebble Mill
1—3' x 8' Marcy Rod Mill

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BLOWERS
3—TM-8 Coppus Ventair, 15 HP
3—TM-6 Coppus Ventair, 5 HP
1—SM-425 Coppus Vano, 15 HP
1—SM-250 Coppus Vano, 1 HP
1—TM-5 Coppus Ventair, 2 HP
10—#2 Buffalo Mine Type, 3 HP
2—Joy Axivane 1-155 230 V DC

CAGES, VERTICAL
3—36" x 5', 40" between guides
1—30" x 46" floor—35" guides

CARDOX CHARGING PLANTS
1—Koreshell complete plant
1—Cardox complete plant with barrels

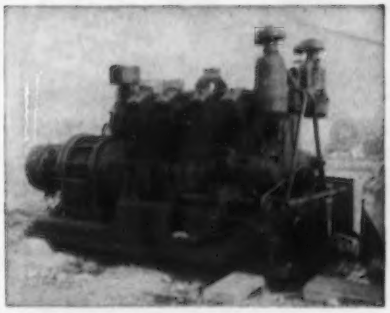
CARS
30—18 cu. ft., 18 gauge, RB, Card trucks, new bodies

CLASSIFIERS
1—8' x 26" Duplex Denver Rake
4—6' x 25' Dorr Duplex Rake
1—4½' x 16' Dorr Duplex Rake
1—24" x 11' Akins Spiral

COMPRESSORS
1—I-R 990 CFM, 200 HP motor
2—I-R 284 CFM, 75 HP motors
2—445 CFM, D-13000 Cat Engines, skidded

BELT CONVEYORS
1—48" x 81' centers, steel frame, 10 HP
1—36" x 120' Jeffrey—steel bridge frame and catwalk
1—18" x 56' Pioneer, bridge frame

CRUSHERS
2—2' Symons Std. Cones, 30 HP motors
1—9 x 16 Rogers, late model, jaw
1—9 x 36 Cedar Rapids, jaw



LABORATORY EQUIPMENT
2—9½K McCool Pulverizers
1—9½K DFC Pulverizer
2—Braun Type UA Pulverizers
1—Wilfley Table #13-S, 24" x 50"
9—Analytical and button balances
1—4½" x 10" Davis Jaw Crusher

FLOTATION EQUIPMENT
2—6-cell #15 Denver Sub A
1—5-cell #9-S Fagergren, 36"

DIESEL GENERATOR SETS
1—300 KW, 480 V. G.M. Engine, air starting
1—250 KW, 480 V. G.M. Engine, air starting
2—112½ KVA, 480 V. Cat. D-17,000 engines
2—100 KW, 480 V. Cummins L.I. Engines

HOISTS, MINE SHAFT
1—250 HP 2-drum shaft hoist, Denver
1—200 HP, 1-drum Nordberg, complete
1—150 HP, 1-drum Ottumwa
3—125 HP, 1-drum, herringbone gears

HOISTS, TUGGER AND SLUSHER
3—I-R HNN1J 2-drum air
5—I-R 25 MNN3D, 3-drum electric
2—I-R 20 MN2D, 2-drum electric

BALL AND ROD MILLS
3—5 x 10 Allis Chalmers, Rod
1—5 x 10 Stearns Roger, Rod
2—6' x 22" Hardinge Conical, 50 HP
1—7' x 36" Hardinge, 100 HP
1—7' x 48" Hardinge, 150 HP motor
2—4 x 5 Eimco & C.I.W., 40 HP
1—5 x 6 Allis Chalmers

LOCOMOTIVES
7—Mancha Titan A & B, 18" or 24" gauge, 3½ ton capacity
1—G.E. 2½ ton, Battery, 18-24 gauge
1—Plymouth 10-ton diesel, late model, std. RR gauge

MUCKING MACHINES
5—Eimco 12-B, 18-24 ga. Rebuilt
1—GD-9 Gardner Denver, 18" ga. Rebuilt

TRANSFORMERS
2—250 KVA Allis Chalmers, 2400-480 V.
1—750 KVA Pittsburg, 44,000-2300 V.
1—1000 KVA G.E., 44,000-2300 V.

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54 x 24, 42 x 16, 36 x 16 & 30 x 16.

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1—48 x 60, 1—42 x 48, 1—30 x 42, 2—24 x 36.

NEW 42 IN. CONVEYOR BELT
1670 FT. 6 PLY 3/16 T. 1/16 B. PRICE $9.50 PER FT.

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10'x48', 8'x48', 8'x22', 6'x22', 6'x36', 5'x36', 3'x7', 4'x5', 4'x7', 4'x14', 3'x10', 5'x14', 5'x10', 6'x7', 6'x8', 6'x9', 8'x10', 7'x5', 7'x9', 7'x7', 8'x12', & 8'x6'.

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12.7 CFM	1000 psi	2 stage Ingersoll 5 HP Elec
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122 CFM	100 psi	American 20 HP Elec
125 CFM	100 psi	6½x4½ Davey VB9-6 Available
142 CFM	125 psi	6/6/5x5 Ingersoll Type 40—25 Elec
211 CFM	100 psi	9½ x 9 American 40 HP Elec
254 CFM	100 psi	10 x 10 Ingersoll ER-1 40 HP Elec
268 CFM	500 psi	10/4¼x10 Ingersoll 75 HP Syn
278 CFM	125 psi	2 stage Chicago PB-50 HP Elec
285 CFM	125 psi	2 stage Gardner "WB" 50 HP
291 CFM	40 psi	3 cylinder Ingersoll Type 40
343 CFM	500 psi	11/5x15 Worth Elec or steam
348 CFM	100 psi	12.7½x8 IR-XRB
360 CFM	125 psi	12-7½x10 Penn
364 CFM	20 psi	12 x 7 Gardner "RX" 2 avail.
426 CFM	100 psi	12 x 11 Ingersoll ES-1 NL—Oil-less
426 CFM	100 psi	12 x 11 Ingersoll ES-1 75 HP Elec
460 CFM	125 psi	13/9x10 Ingersoll XRB—Duplex
510 CFM	125 psi	13/9x12 Ingersoll XRB—Duplex
676 CFM	125 psi	15/9½x12 Ingersoll XRB—Dup.
861 CFM	30 psi	17 x 11 Ingersoll ES-1
931 CFM	55 psi	17 x 13 CPT Elec or steam
1085 CFM	35 psi	20 x 12 Penn.3A 100 HP Elec
1292 CFM	35 psi	20 x 13 Chicago T-B 125 HP Elec
1574 CFM	100 psi	22-14x16 IR-PRE
1723 CFM	110 psi	"XPV" 4 corner Ingersoll steam

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PORTABLE—15 CFM to 600 CFM
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Tube & Ball Mills—5' x 22'—5½' x 20'—6' x 22'. 6½' x 40'—7' x 120' & New 6½' x 158' Kilns.
Oliver filters 12 x 10, 14 x 18 & 10 x 9.
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Sturtevant Rotary fine crushers—No. 0—No. 2—Ball Mills 7 x 8'—6 x 12 & 8 x 6.
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Screens—classifiers, thickeners, air separators & filters.
5', 6' & 7' dia. Rod Mills.
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New Dryers—Kilns, Dust Collectors & Lime Hydrators.

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Filter: 5-Leaf 4 ft. Oliver-United.

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2000 CU. FT. COMPRESSOR

Ingersoll Rand XVHE-2 type two stage actual delivery 2000 cu. ft. per min. at 100 lbs. p.s.i. preferably 26" and 15½" x 13" stroke, 300 R.P.M. or very near.

Would consider damaged machine if necessary. No electrical gear.

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a 1250/1500 H.P. Double Drum
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with 12 ft. diameter drums.

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Will pay cash for complete mill for free and pyrite gold ore, with pumps, diesel power and electric motors, 15 to 20 ton capacity. Address:
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SHOVELS: Marion 4161, 5 yd. and Bucyrus Erie 170-B, 6½ yd., electric.

GENERATOR SETS: 2—1000 KW, portable, diesel electric Generator Sets, 4160/2400 volt, 3 phase, 60 cycle, condition like new.

SINK FLOAT PLANT: Mobil 2-unit with two 7 ft. dia. HMS Separating Cones with screens, pumps, magnetic separators, densifiers, demagnetizing coils, piping, valves, framework, etc. with all control equipment.

DRILLS: Ingersoll Rand Quarrymaster, diesel powered condition like NEW. Joy Champion electric. Also, Bucyrus Erie 42-T with 9" bits and tools, hydraulic jacks, diesel motor drive.

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SCREEN: Tyler Hummer type V-50, 4' x 5', double deck, fully enclosed, with Thermionic power converter. Guaranteed condition.

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KILNS: 2—Rotary 8' x 150', 9/16" shell, with coolers, etc. Excellent condition.

JAW CRUSHERS: 48 x 60", 42 x 40", 48 x 36" and 36 x 24", with motors and drive. Rebuilt. Telsmith 18 x 30", all steel, roller bearing equipped. NEW condition.

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HOIST MOTORS:
300 H.P., 435 RPM. 600 H.P., 710 RPM.
400 H.P., 588 RPM. 1200 H.P., 444 RPM.
2200 volt, A.C., with controls.

LOCOMOTIVE CRANE: Link Belt 25 ton capacity, standard gauge, gasoline powered, cast steel trucks, air brakes, with or without 1¼ yd. Williams clam shell bucket, thoroughly modern, excellent condition. Located Minnesota. For sale or rent.

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Complete Ready-Fab sections quickly and easily joined together on the job. We take our loss on our stock of short length belting. You can save as much as 50% on the BONDED CONVEYOR SPECIALS listed, with conveyor belting in two pieces. Conveyors are equipped with 5" roll diam. idlers and return rolls, 20" diam. head pulley and 16" diam. tail pulley mounted on 2¼" or 2-7/16" diam. shaft. Belt is new 4-ply, 28 oz. duck, ¼" top rubber cover x 1/32" bottom cover and is fresh stock made by leading manufacturers.

Remember, You Save Up To 50%

CONVEYOR PRICES INCLUDE BELTING

Belt Width	Length of Conveyor	List Price	Sale Price
16"	20'	$ 991	$ 548
16"	45'	1785	937
18"	25'	1229	684
18"	45'	1839	1005
18"	85'	3209	1665
18"	100'	3704	1912
24"	25'	1322	773
24"	45'	2062	1145
24"	100'	4097	2166
24"	130'	5207	2773
30"	25'	1421	847
30"	65'	3101	1718

LONGER LENGTHS WITH EXTRA FEATURES

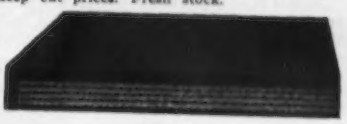
In addition to features described above, these conveyors include Gravity Takeup, Lagged Head Pulley, Self Cleaning Wing Tail Pulley. Head Shaft & Bearings 2-5/16". Tail Shaft & Bearings 2-7/16". Side Guide Idlers—1 pr. each for Head & Tail.) Snub Roll at Head end 12¾" diam. using 1-15/16" shaft & bearings. Ratchet & Pawl Holdback. Return belt cover at slight extra cost.

Belt Width	Length of Conveyor	List Price	Sale Price
18"	150'	$ 6209.00	$3507.00
18"	200'	7859.00	4336.00
18"	250'	9509.00	5164.00
18"	300'	11.159.00	5993.00
24"	150'	6820.00	3949.00
24"	225'	9585.00	5356.00
24"	300'	12.370.00	6763.00
30"	150'	7664.00	4479.00
30"	220'	10.804.00	5971.00
30"	300'	13.964.00	7677.00

Other lengths & belt widths at bargain prices.

NEW CONVEYOR BELTING SAVE 28%

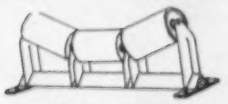
Heavy duty 4-ply, 28 oz. duck, ⅛" top rubber cover x 1/32" bottom cover rubber belting having high tensile strength, tough cotton duck, strong carcass and proper flexibility. For heavy boxes, bags and bulk materials. Troughs easily. Famous brands at deep cut prices. Fresh stock.



Width	List Price	Sale Price
16"	$3.64 foot	$2.62 foot
18"	4.03 foot	2.90 foot
24"	5.23 foot	3.76 foot
30"	6.39 foot	4.60 foot

Additional width and plies available at low prices. Write for free sample.

NEW IDLERS & RETURN ROLLS 25% BELOW LIST PRICE



3-roll, 5" diameter Troughing Idlers for

16" belt	$17.25	30" belt	$19.50
18" belt	18.00	36" belt	20.25
24" belt	18.75	48" belt	21.75

1-roll, 5" diameter Return Idlers for

16" belt	$ 6.75	30" belt	$ 8.25
18" belt	7.13	36" belt	8.75
24" belt	7.50	48" belt	10.25

All steel. Interchangeable with other well-known makes. Replaceable ball bearings. Either sealed type (pre-lubricated) or with alemite fittings. Rust proof ball races. Maintenance is negligible.

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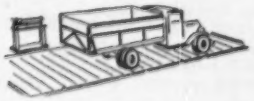
For stationary and portable applications. Scales have steel lever system complete with structural steel weighbridge. Capacities to 50 tons. Recording beams available.



20 Ton Truck Scales	$525.00
26 Ton Truck Scales	782.00

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Mfrs. of Scales, Conveyors, Conveyor Parts, Idlers, Vibrating Screens, Crushers and Feeders
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FOR SALE

1 Herreshoff 16'—8 hearth mercury furnace	$10,000.00
1 Allis Chalmers 6' x 15 tube mill	$ 1,500.00
10 Tons 30-35 lb. mine rail (per ton)	$ 75.00
1 Ball mill 3' x 4' O. D. (slight use)	$ 750.00
10 Tons 1¼" round lyner drill steel with attached sharp B. S. bits. Per ft.	$ 0.50
1 Dorr 12' Turret Bowl Classifier	$ 2,500.00
1 Hardinge Conical 6' Ball Mill	$ 3,000.00
1 Wilfley 14' Concentrating Table & Motor	$ 750.00
1 Productive 4x6 Shaking Screen & Motor	$ 700.00
1 Traylor 2½x6 Shaking Screen & Motor	$ 500.00

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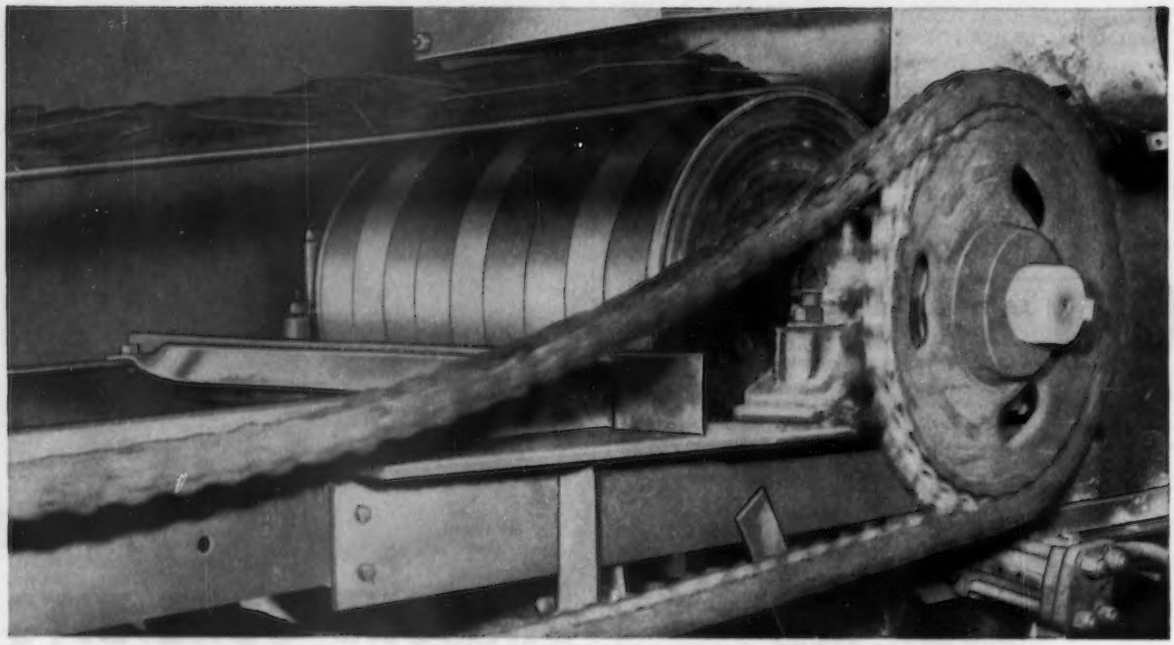

Studebaker-Packard uses this 18" by 24" Homer Hercules Permanent Magnetic Pulley to remove core rods and other tramp iron from molding sand following shakeout of foundry molds . . . thus reclaiming good reusable sand and protecting succeeding equipment from possible tramp iron damage.

Quality of product and performance go hand in hand regardless of whether it's manufacturing—mining or processing.

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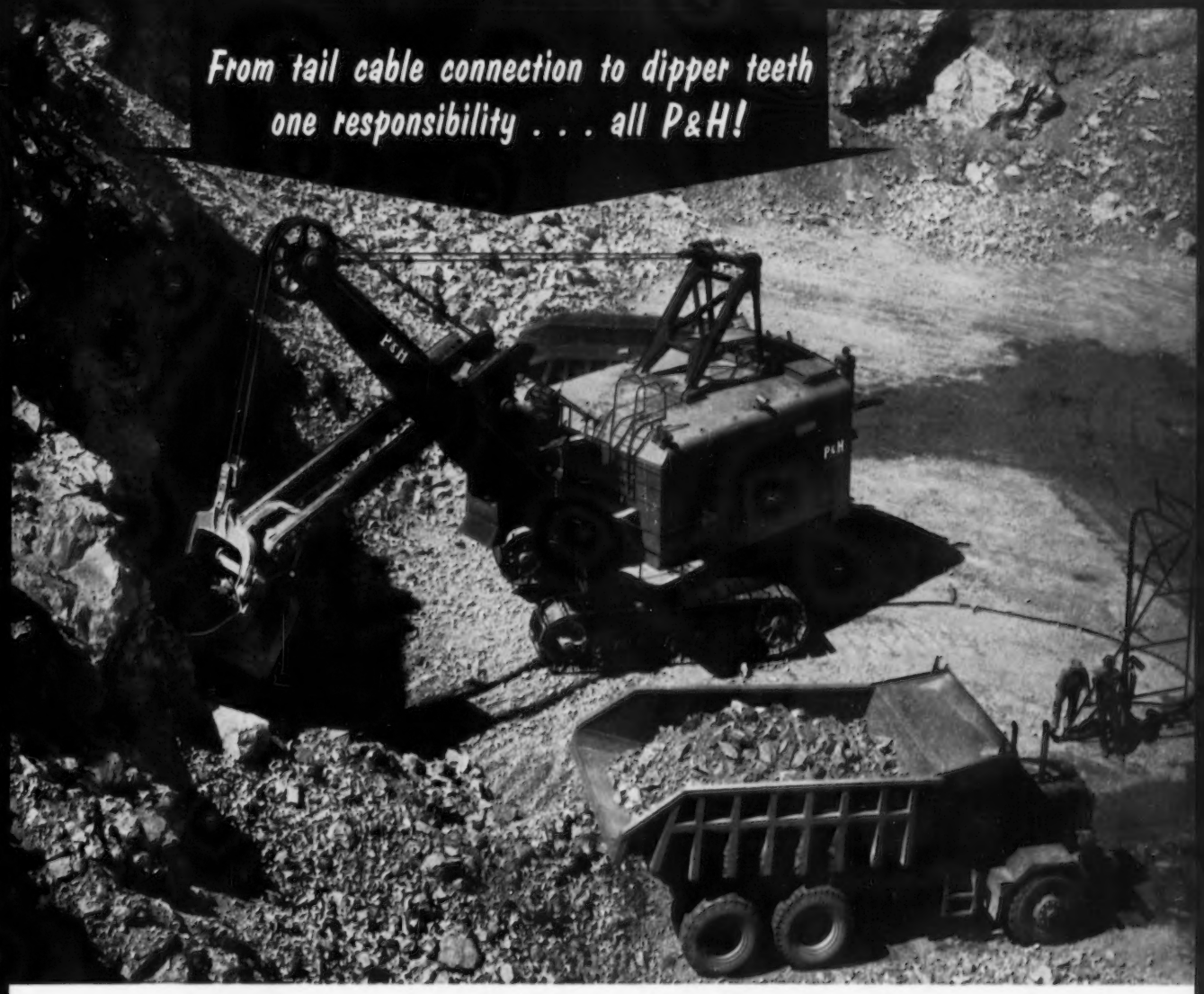

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*T.M. of Harnischfeger Corporation for electro-magnetic type coupling.

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the P&H Line

Auger mines 700 tons of coal per shift

with TIMKEN® bearings taking the thrust loads

THIS Compton Auger, manufactured by Compton, Inc., Clarksburg, West Virginia, actually pulls coal out from underneath overburden and loads it on a truck at the rate of three tons a minute. Even with necessary auger shaft changes it mines 700 tons of coal per normal shift with a maximum four-man crew.

A 300-hp engine forces the auger into the seam. The tremendous resulting thrust load is carried by Timken® tapered roller bearings on the auger shaft. On top of this, the Timken bearings support the heavy weight of the shaft itself. Being tapered, Timken bearings take *both* radial and thrust loads.

Shock loads aren't a problem either. Timken bearings are case-hardened to give them hard, wear-resistant surfaces over tough, shock-resistant cores. And full line contact between their rollers and races gives Timken bearings load-carrying capacity to spare.

Wear is held to a minimum because Timken bearings practically eliminate friction. They're designed to roll true and are precision manufactured to live up to their design. We even make our own steel to control quality all the way. No other U. S. bearing manufacturer does.

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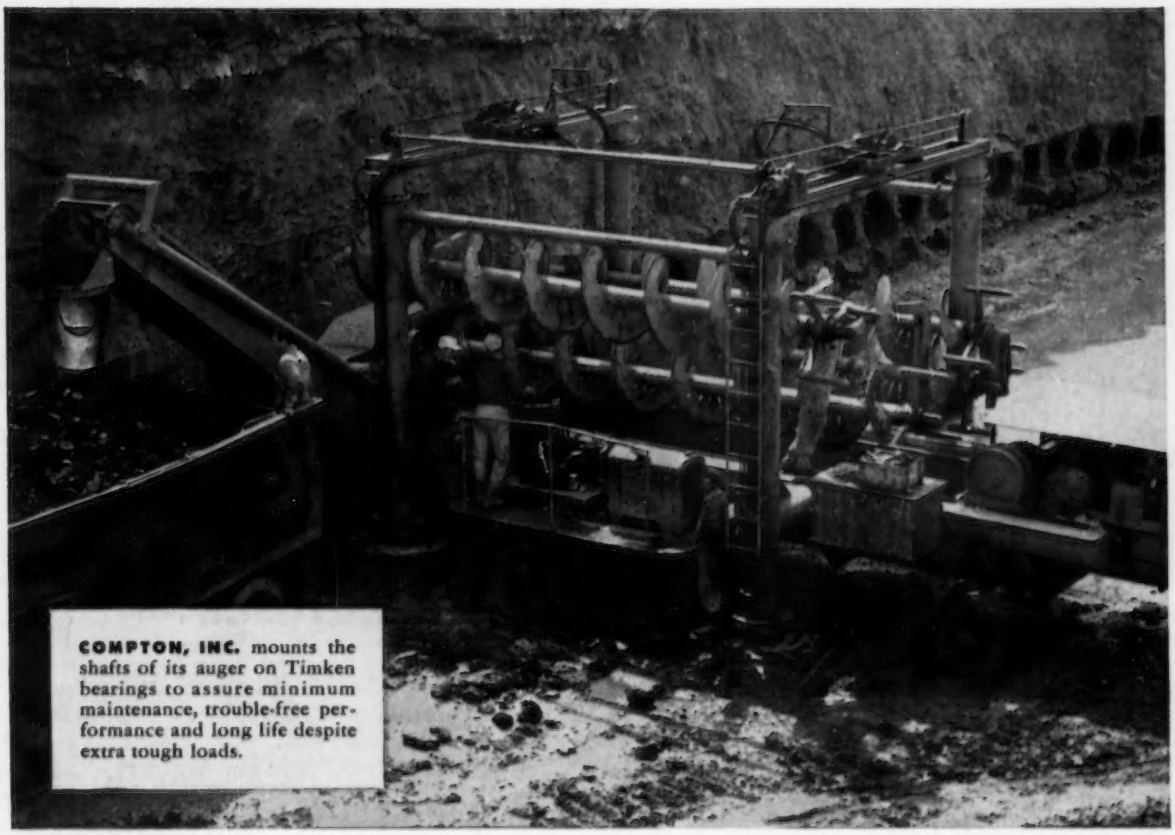
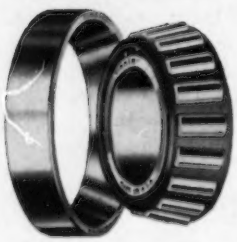
This symbol on a product means its bearings are the best.



COMPTON, INC. mounts the shafts of its auger on Timken bearings to assure minimum maintenance, trouble-free performance and long life despite extra tough loads.



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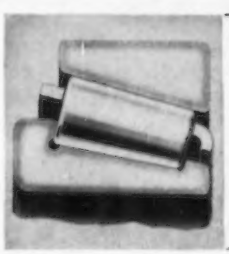

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